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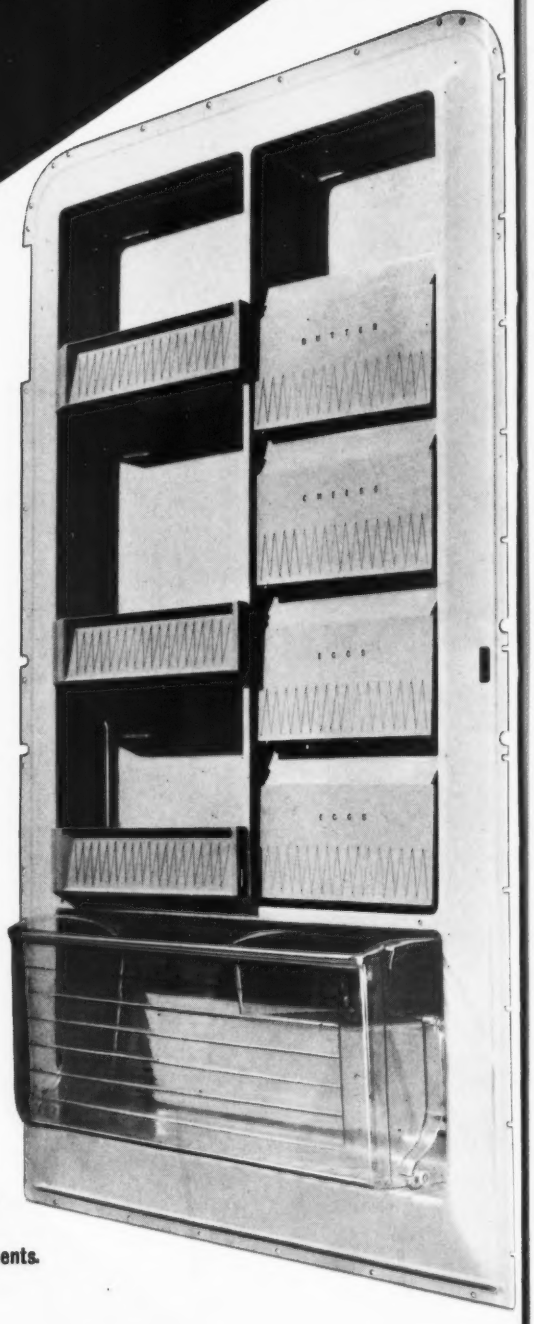

Sheet and powder mouldings in Bextrene by EKCO Plastics Ltd.

The Frigidaire* Model DY-94 domestic refrigerator incorporates a number of components made of Bextrene.

Bextrene GP crystal powder for transparent containers.

Bextrene BC15 (toughened) powder for impact-resisting trays and components.

Bextrene toughened polystyrene sheet for formed door liners.

Well known for its superb finish, wide range of colours, chemical resistance and dimensional stability, Bextrene is the name relied upon by leading moulders for all types of polystyrene moulding.

*Registered Trade Mark

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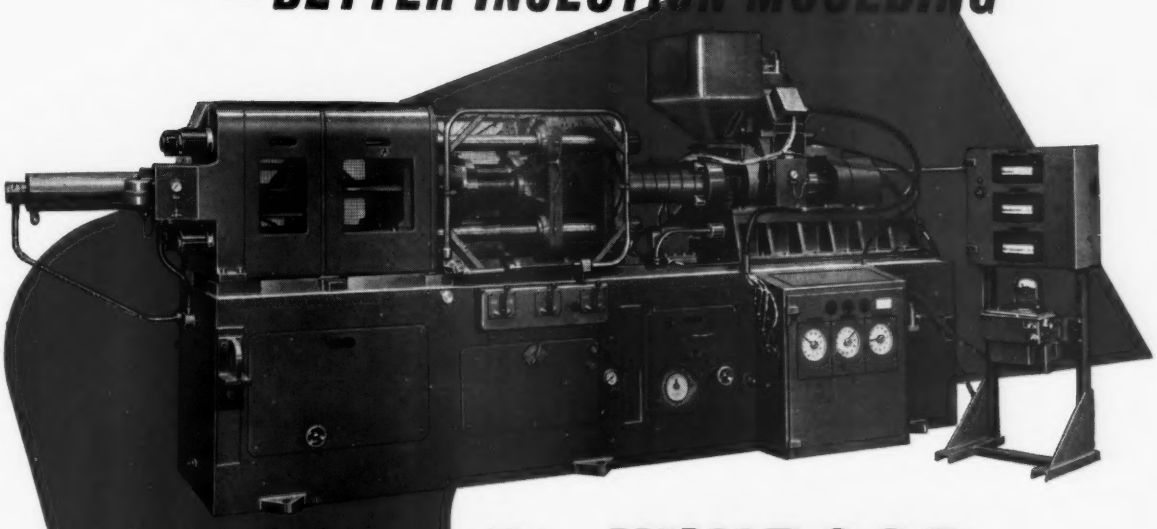

THE THREE ITEMS ILLUSTRATED ARE TYPICAL EXAMPLES OF THE PERFECTLY FINISHED MOULDINGS PRODUCED BY THE 1044 'AUTOPLAS'

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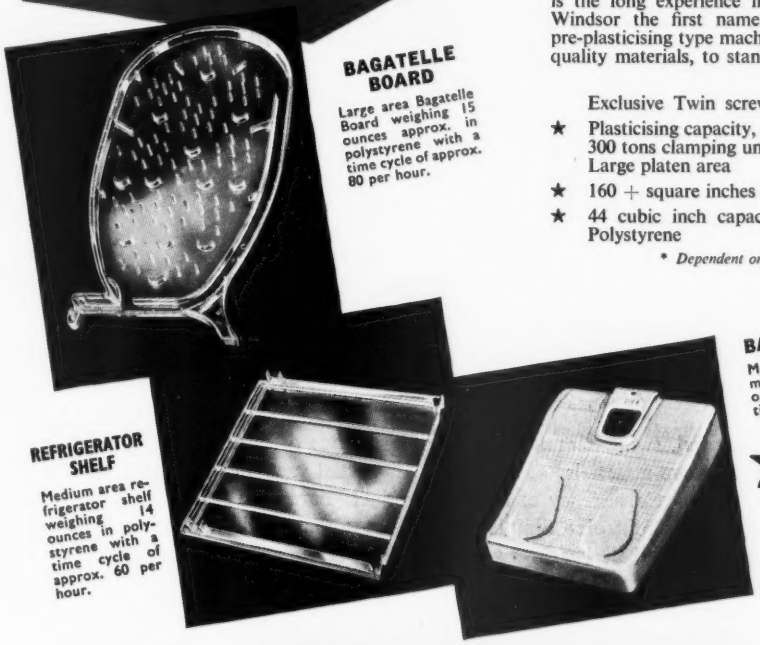
* *Dependent on mould construction and materials*



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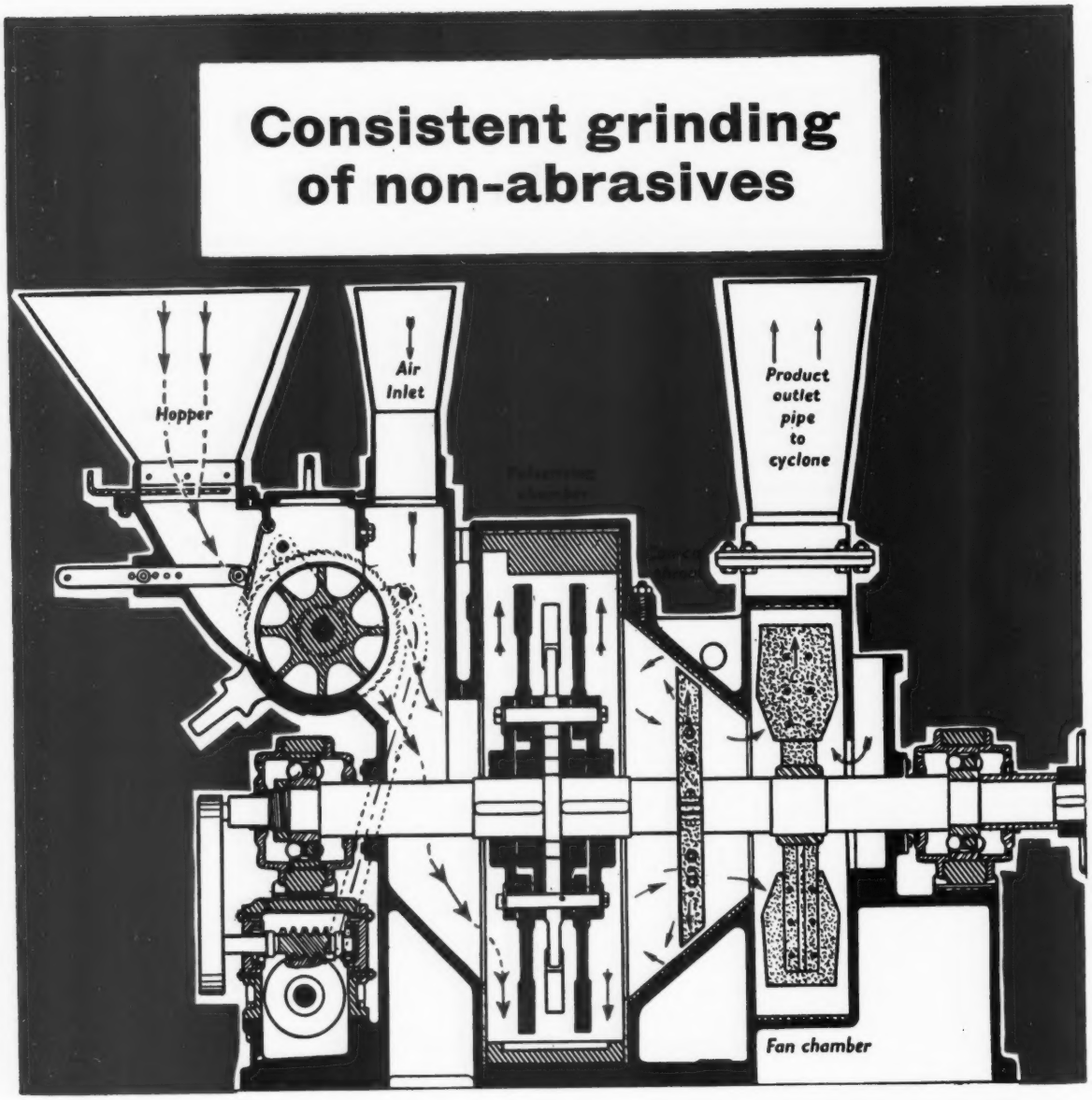

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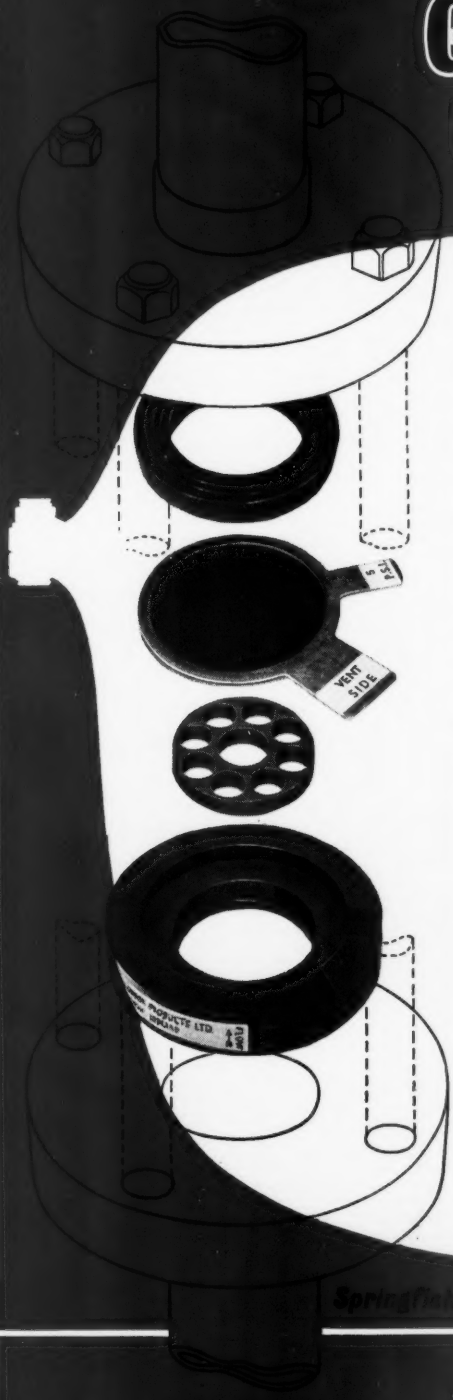

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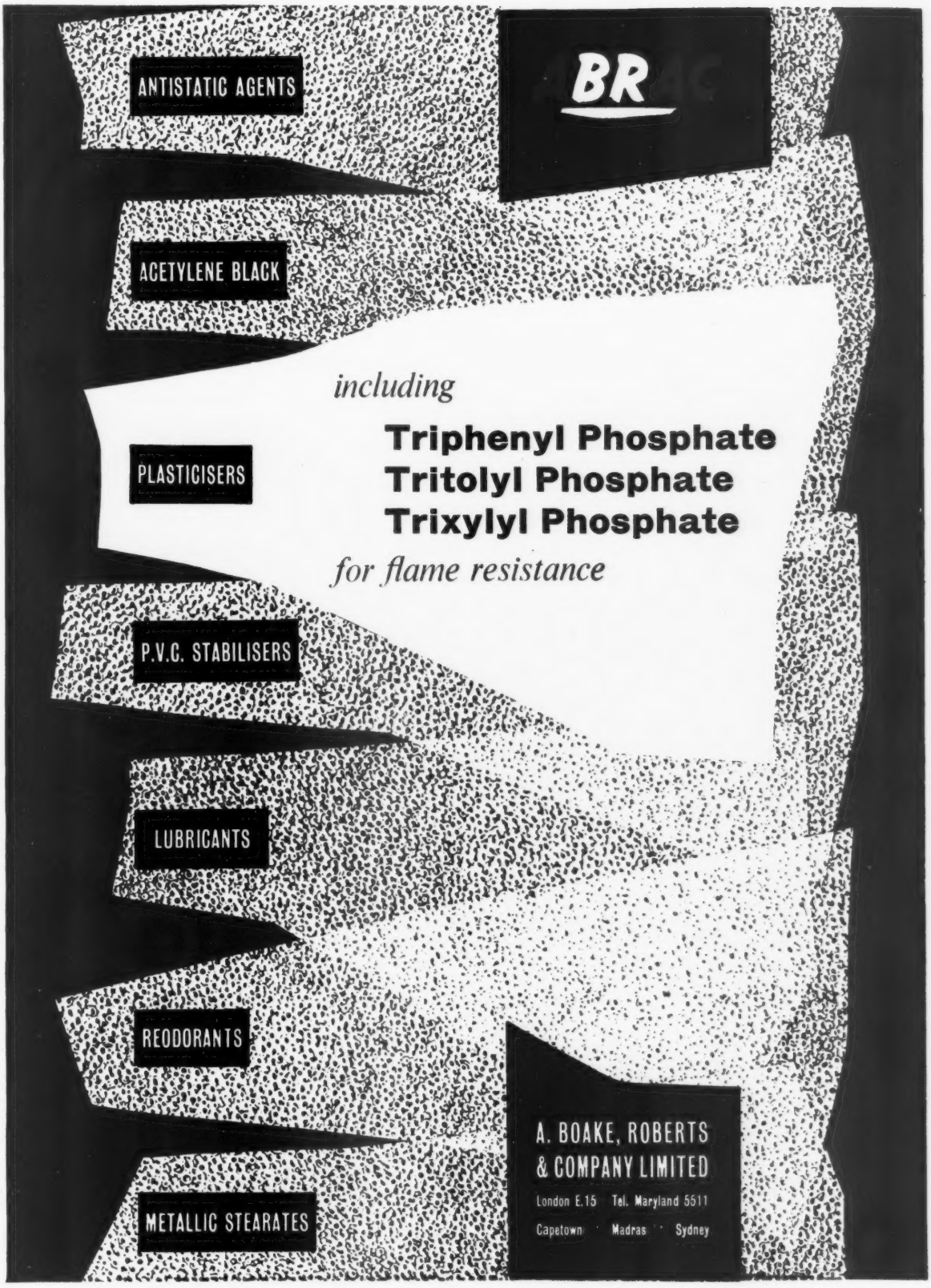
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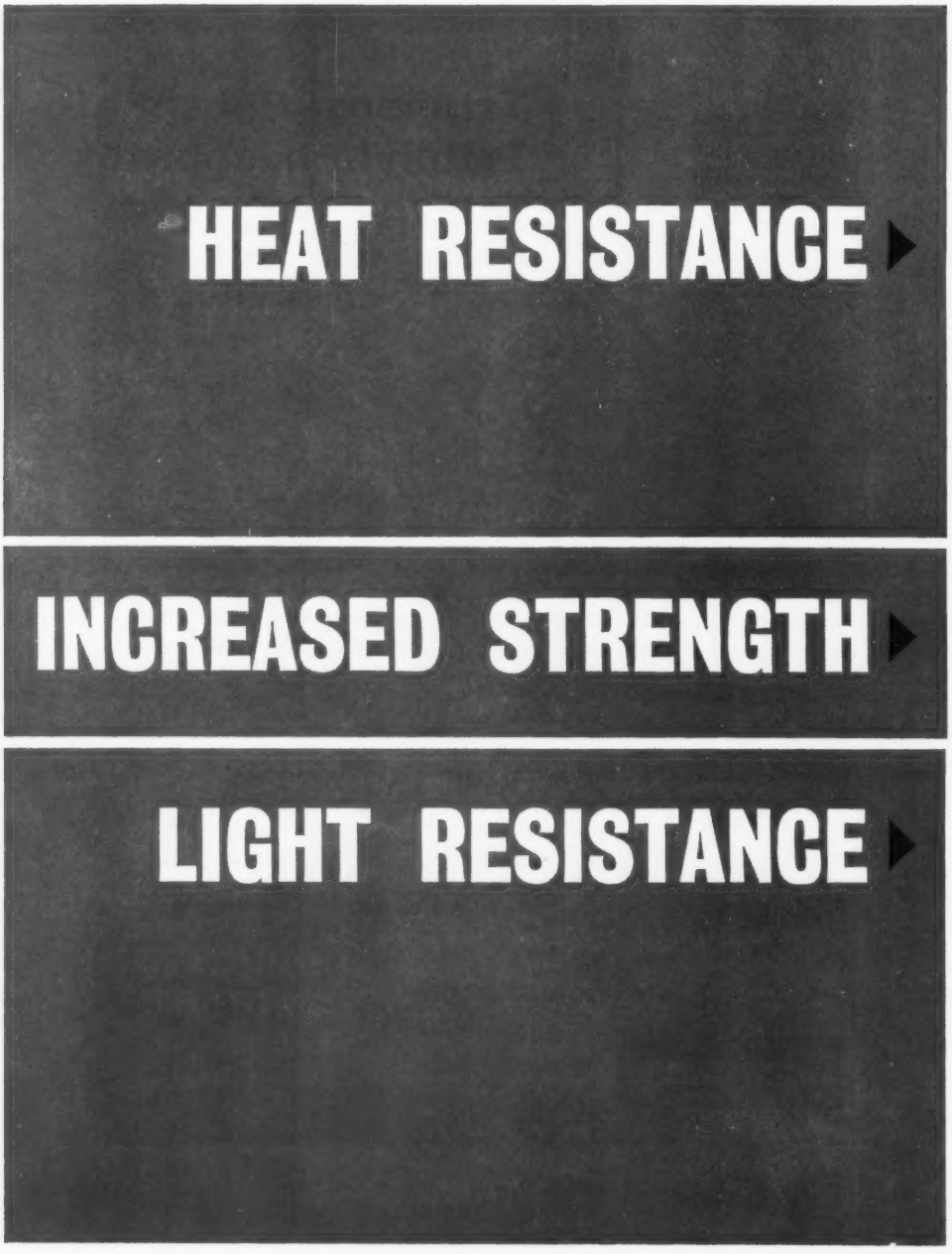

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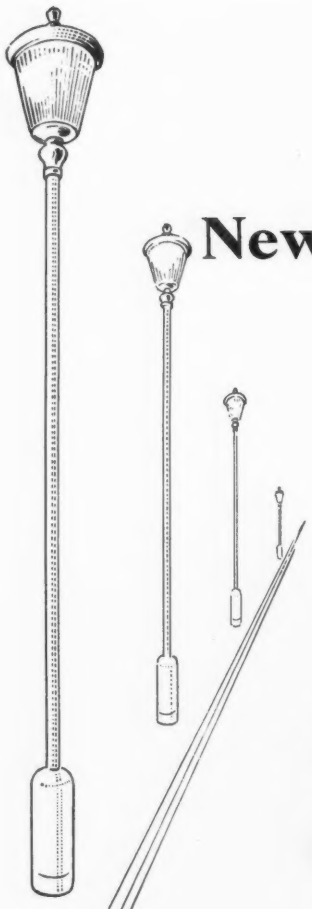

A clear transparent Diakon moulding, fluted in a truncated cone, is used in the body of this new G.E.C. post top lantern. Clear Diakon is used also for the moulding at the lower part of the lantern body, allowing light to reach the foot of the pole. This particular application of modern plastics technique was carried out by the Witton Moulded Insulation works of the G.E.C., for the Exterior Lighting Department. But the plastics experts of the G.E.C., with over 40 years' experience to call upon and the whole vast research laboratories of the company behind them, are all the time working with plastics for firms in many industries. They could work for you, too.

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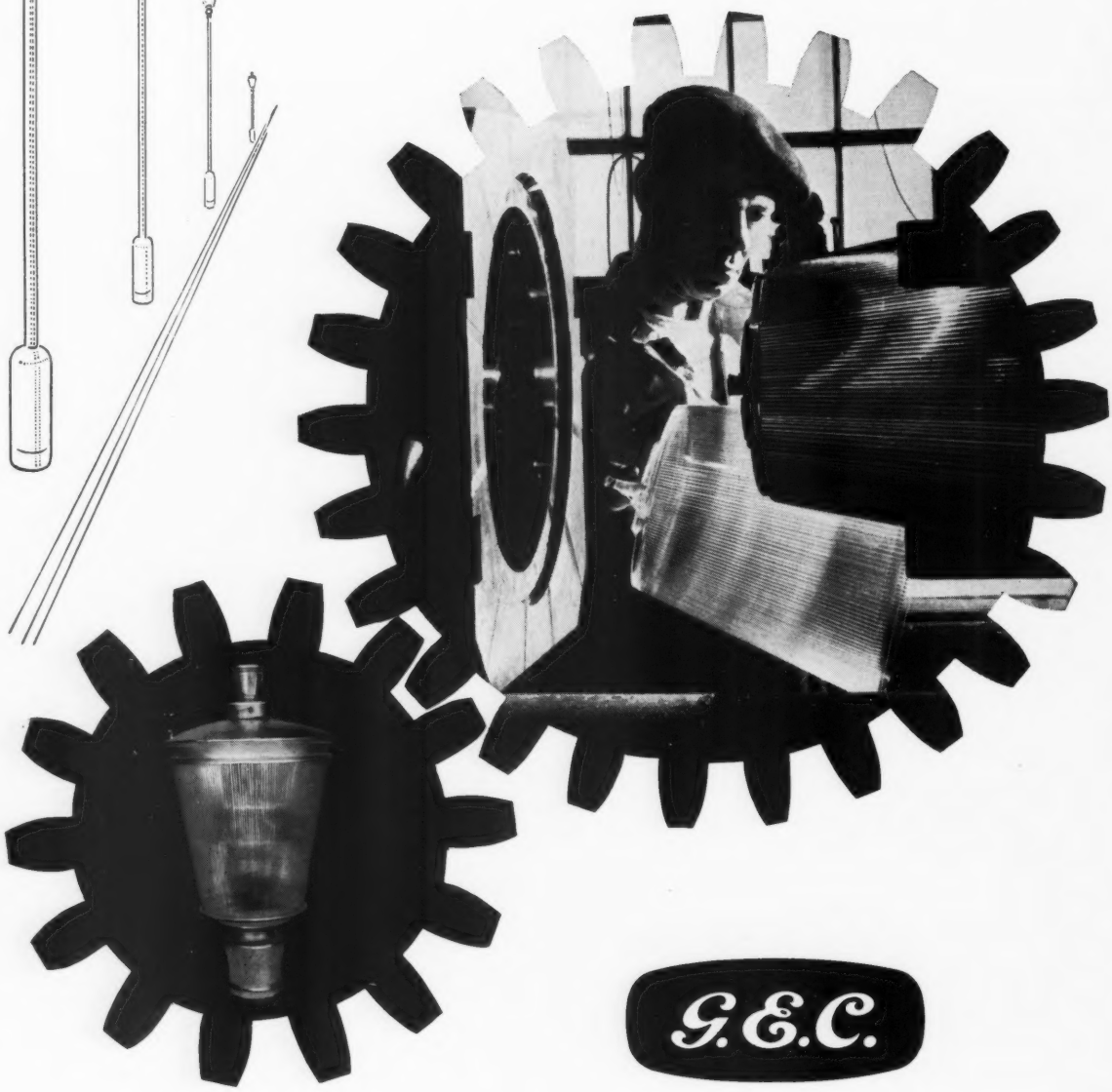

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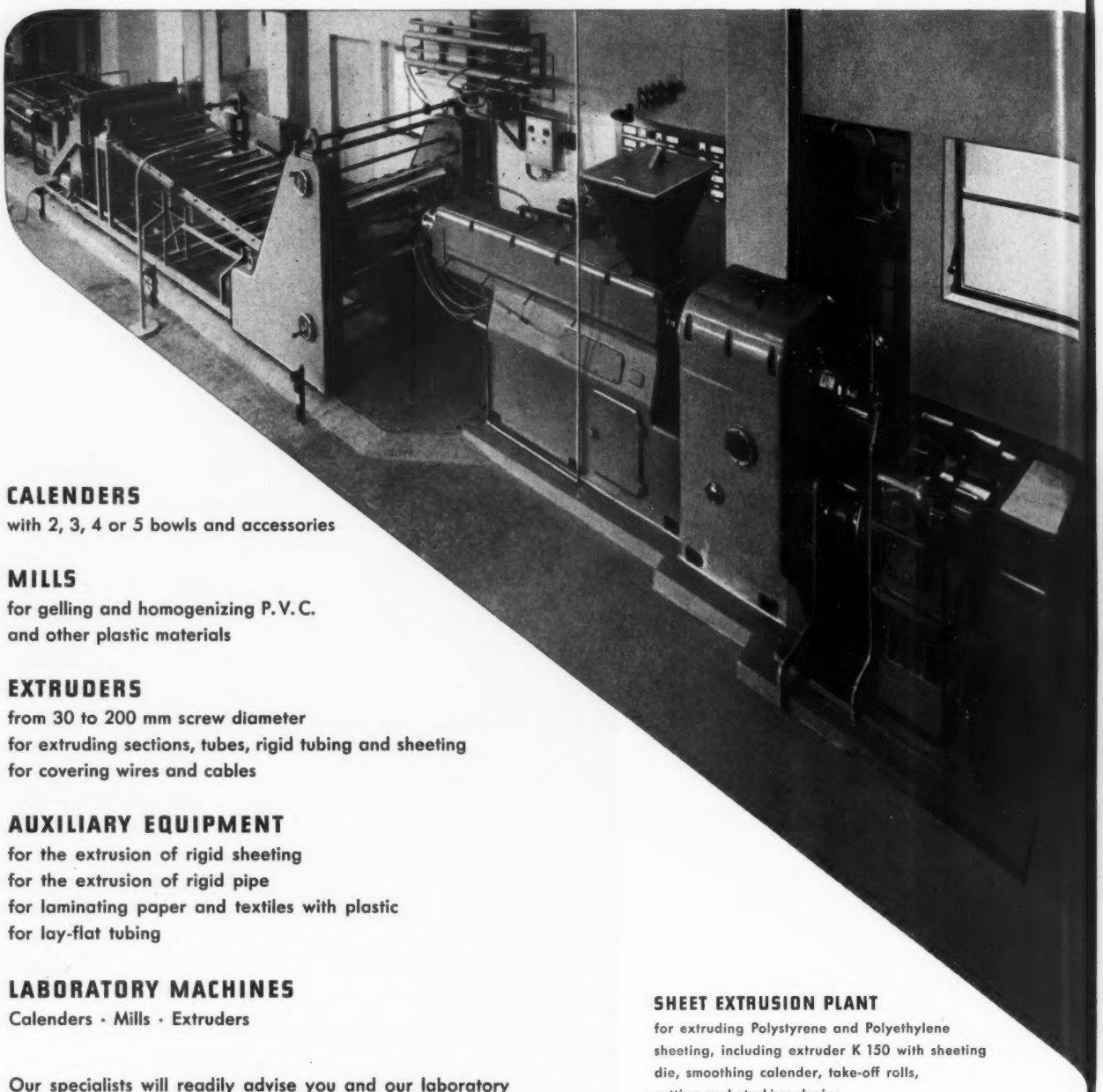

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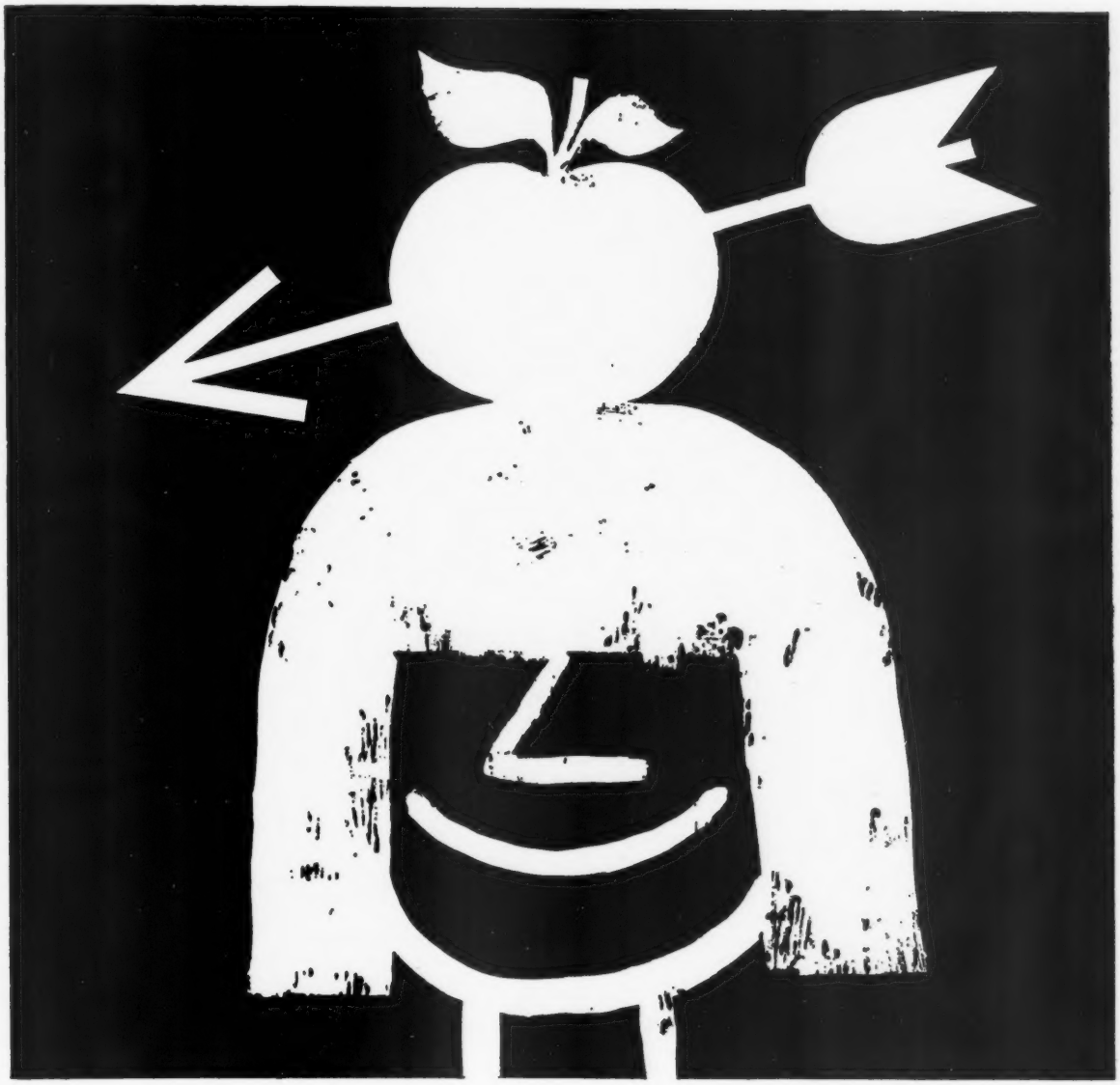

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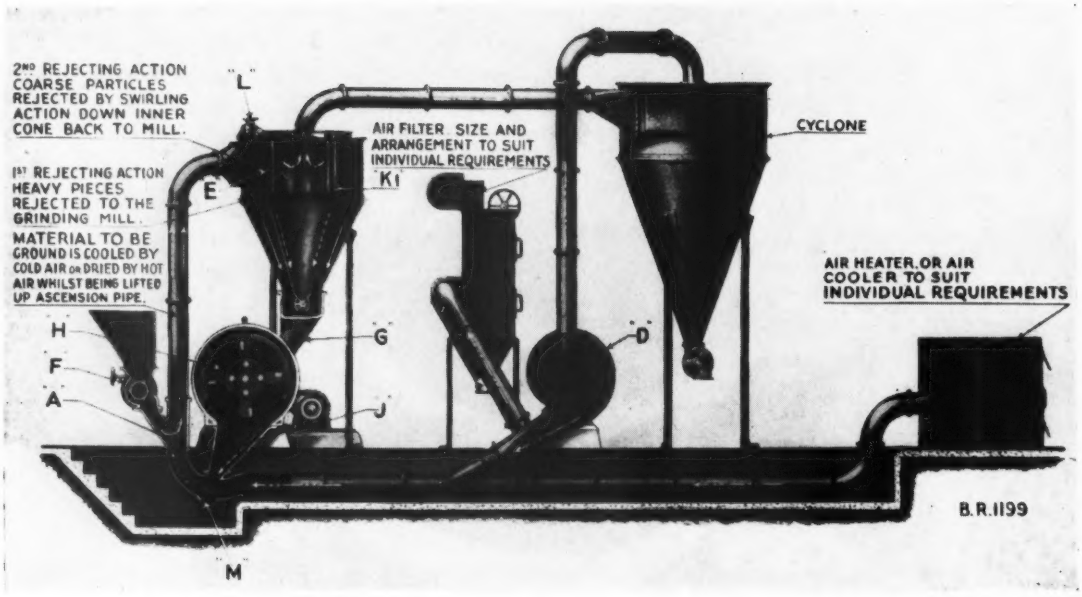
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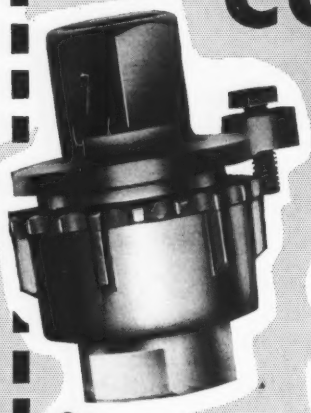
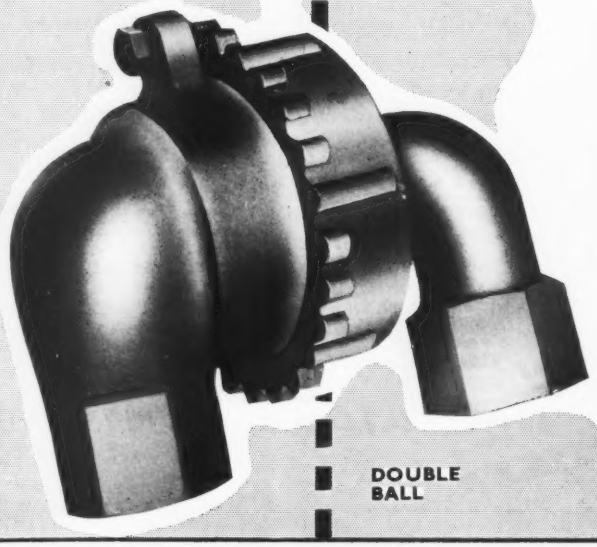


SINGLE SWIVEL



DOUBLE BALL

(Patent Nos. 614876 & 625612.)

DURABILITY of Rigid Pipe with FLEXIBILITY of Hose...

Simplicity of design and ease of maintenance are outstanding features of J. R. H. Pipe Couplings which allow for reciprocating or rotary movement on pipe joints for Water, Steam, Air, etc. Full pipe section is maintained through 360° for tested working pressures up to 300 lbs. p.s.i. (steam) at 500° F.

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Packing adjustment may be effected while coupling is under working pressure. (Special moulded packings in compressed Asbestos, Metallic Foil, or P.T.F.E. are employed).

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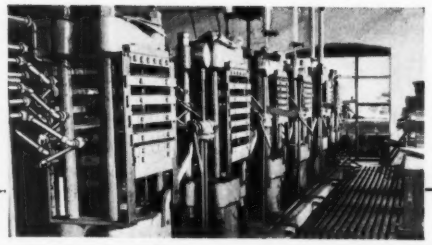

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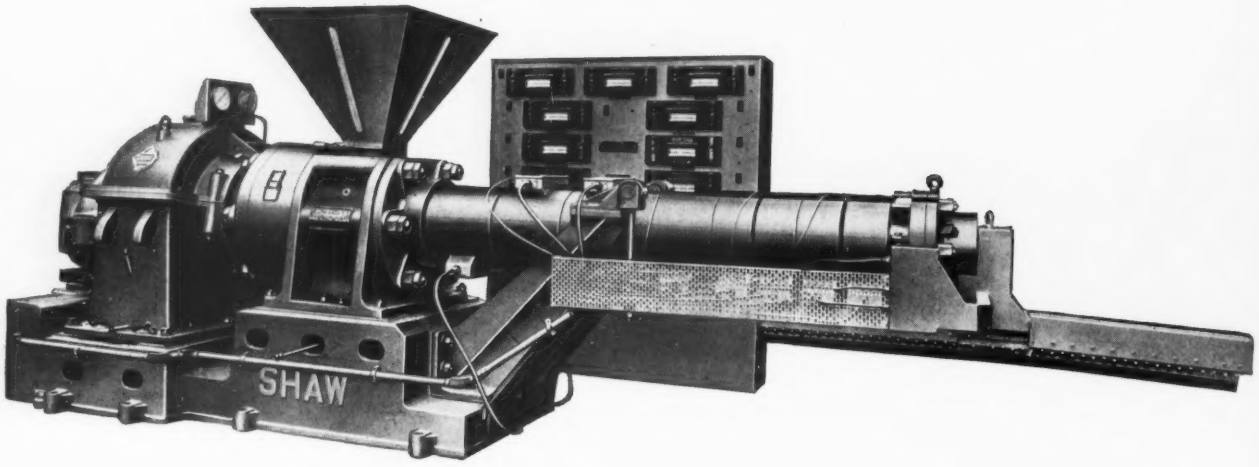

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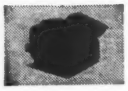
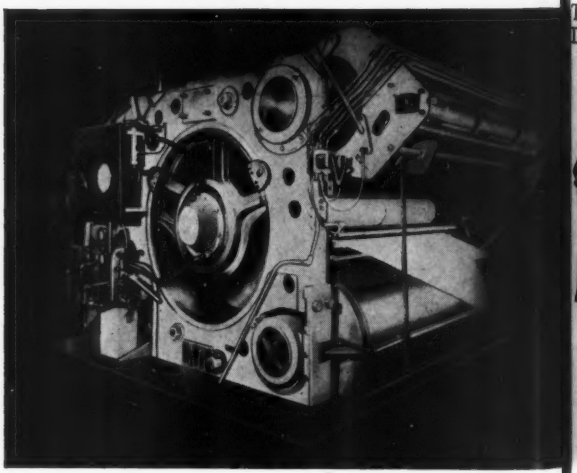
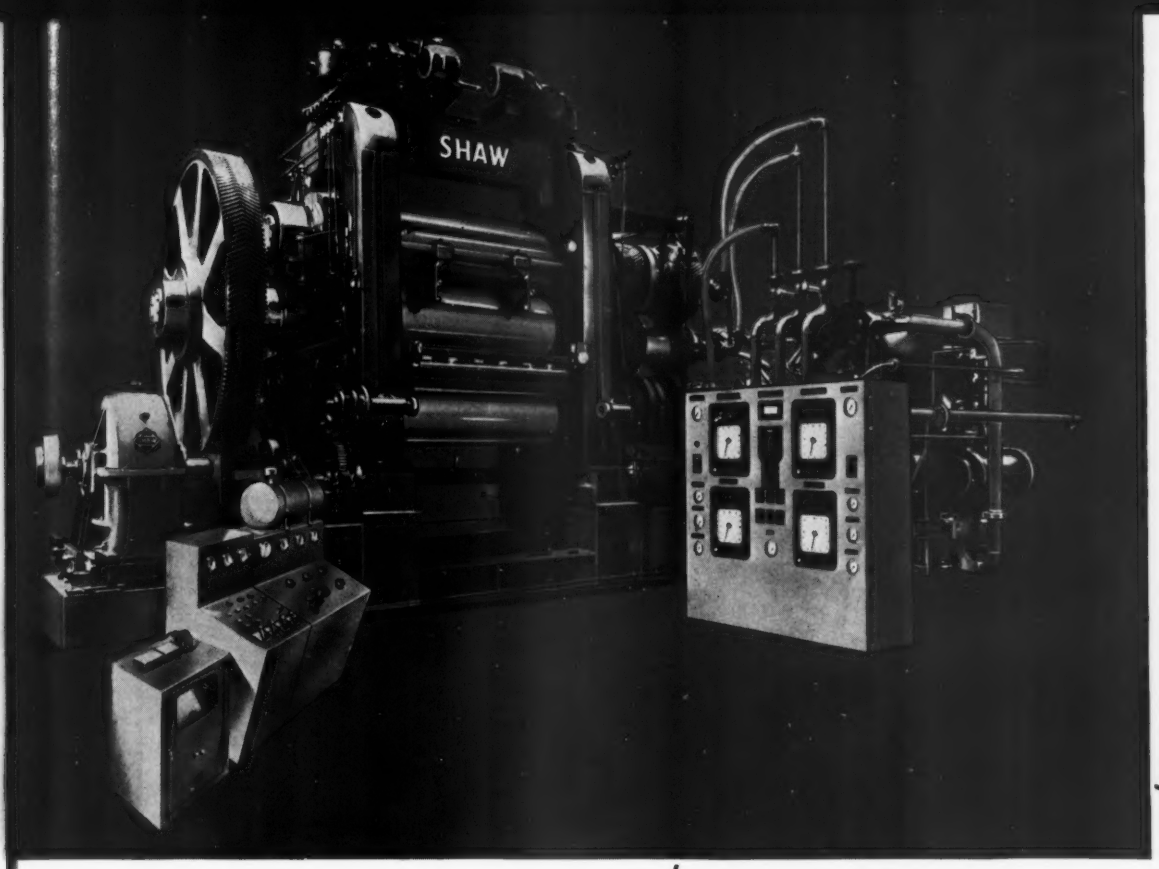
The cost-cutting performance of every Francis Shaw machine and its thorough dependability are the result of long experience and unvaryingly high standards of engineering in every detail of manufacture.
Close-limit accuracy and rigorous inspection during manufacture guarantee to the user a consistently high quality output from Francis Shaw equipment.



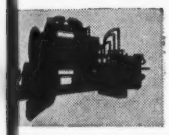
SHAW ROTOCURE. For perfect quality continuous curing of belting, matting, flooring and other flat products, eliminating the time-wasting operations of opening, cooling, re-heating and closing of hydraulic presses.



QUALITY ENGINEERING FOR QUANTITY PRODUCTION



Francis Shaw are available for the design, manufacture and installation of a wide range of processing equipment



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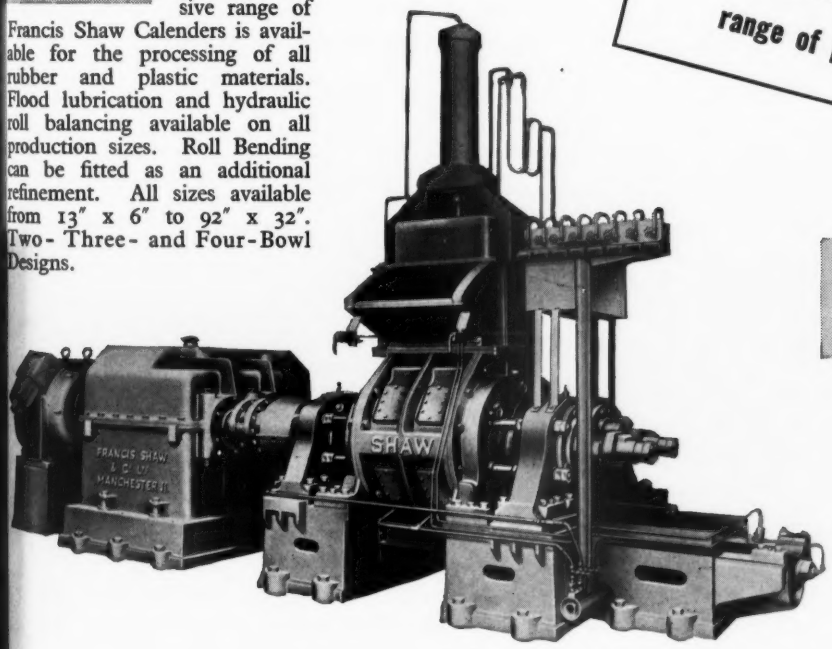

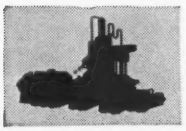

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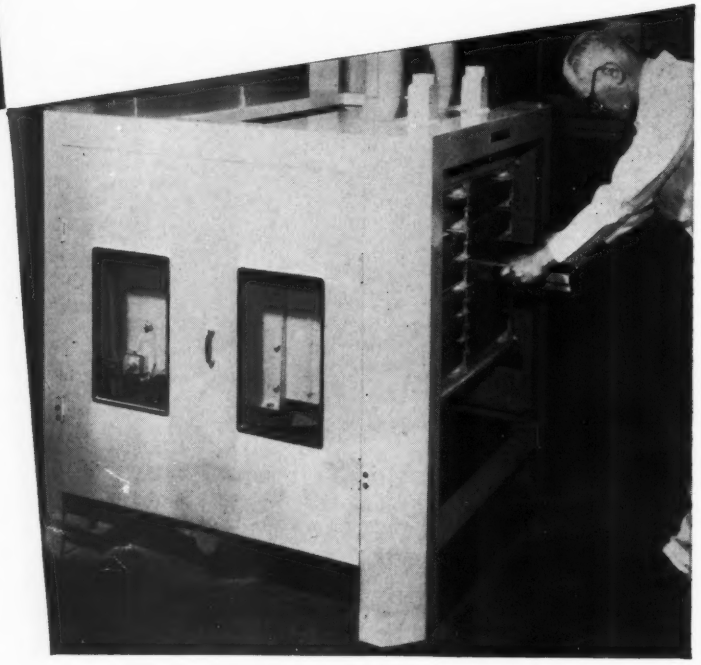
Sifting problems?



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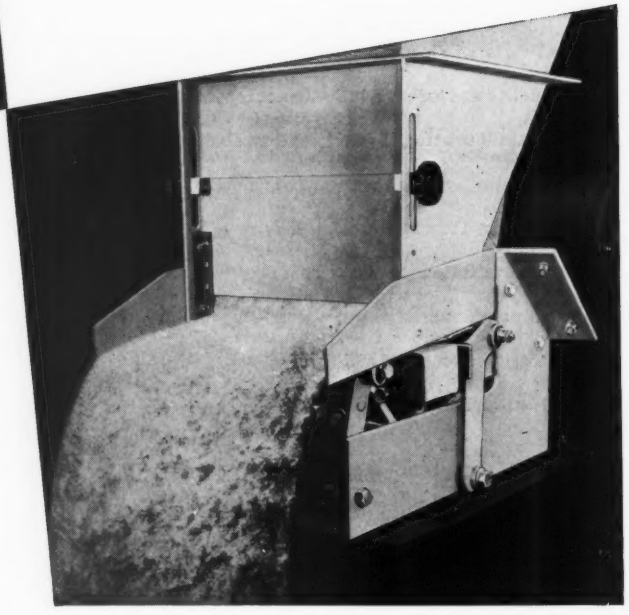

Then use the Simon vibratory Velofeeder. It gives a controlled accuracy of feed on all solids from powders to 2″ lumps. Adjustments are made in seconds from high to low discharge rates within a 400-1 ratio.

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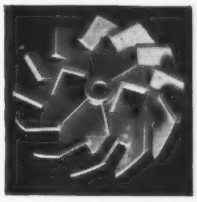
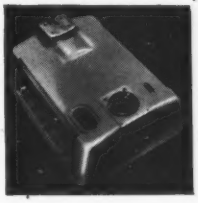
precision mouldings
of strength and stability



Ralsin injection moulding powder

(NYLON 11)



Even by current high standards, Ralsin (Nylon 11) injection moulding powder is exceptional—and custom moulders will quickly acknowledge the fact. Ralsin precision mouldings—strong, lightweight and dimensionally stable are already being applied with singular success in the fields of accountancy and computing machinery, automotive engineering and textiles. Gears made from Ralsin are silent, self-lubricating; a slight 'give' in the material permits perfect engagement and protracted use without wear. Ralsin has excellent electrical insulation properties, is indifferent to water, heat and cold and will withstand temperatures of 100°C continuously.

What the custom moulder will want to know about Ralsin moulding procedure, physical properties and special suitabilities, is contained in Publication No. TD/R/2. Engineers and Designers are invited to request a copy.

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Low water absorption.
Dimensional stability.
Excellent mechanical properties.

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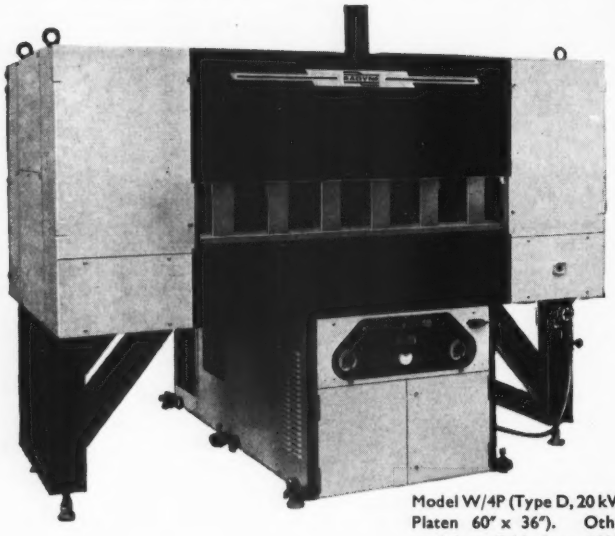
W18

RADYNE
4-Pillar fast acting press for electronic bonding of upholstery



Model W/4P (Type D, 20 kW, Platen 60" x 36"). Other models available from 6 kW, platen 42"x 26".

Radyne general-purpose open-span electronic bonding press

Model W/2P
Output 6 kW.

These latest Radyne welders — of patented construction and pneumatically operated — are specially designed for fast and reliable welding including thin sheet and difficult padded assemblies. Model W.2P has adjustable stroke — 1" to 8" and can accommodate extra long electrodes — more than 42". Model W.4P is available in a range of types and sizes and is exceptionally compact. It is fast operating — open close cycle, 2 seconds — and can be fitted with special loading frames.

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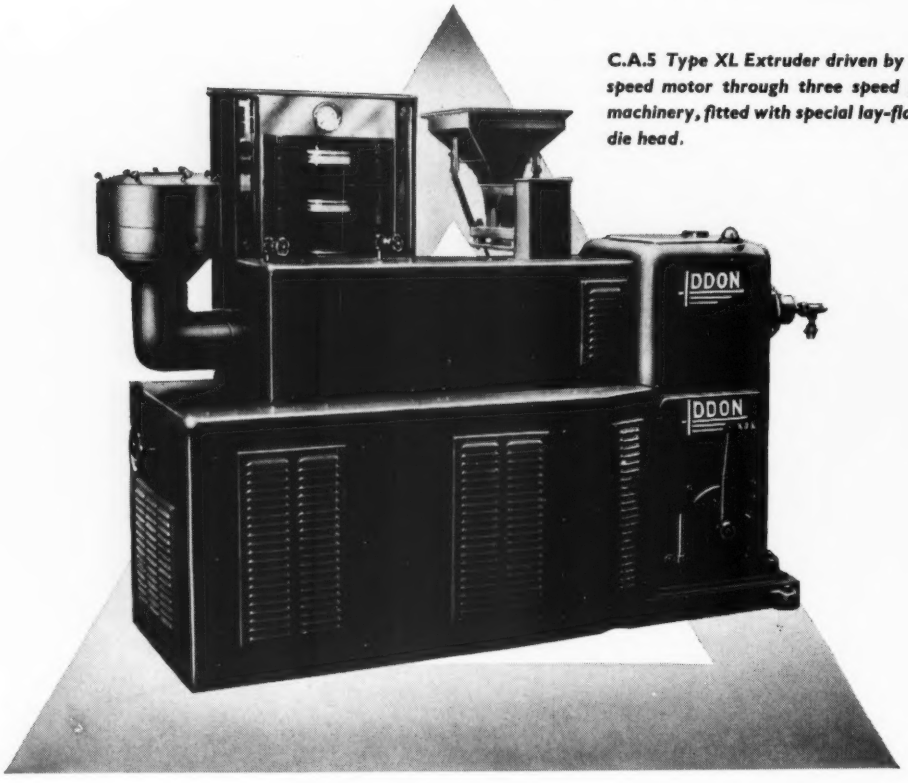

C.A.5 Type XL Extruder driven by variable speed motor through three speed gearbox machinery, fitted with special lay-flat tubing die head.

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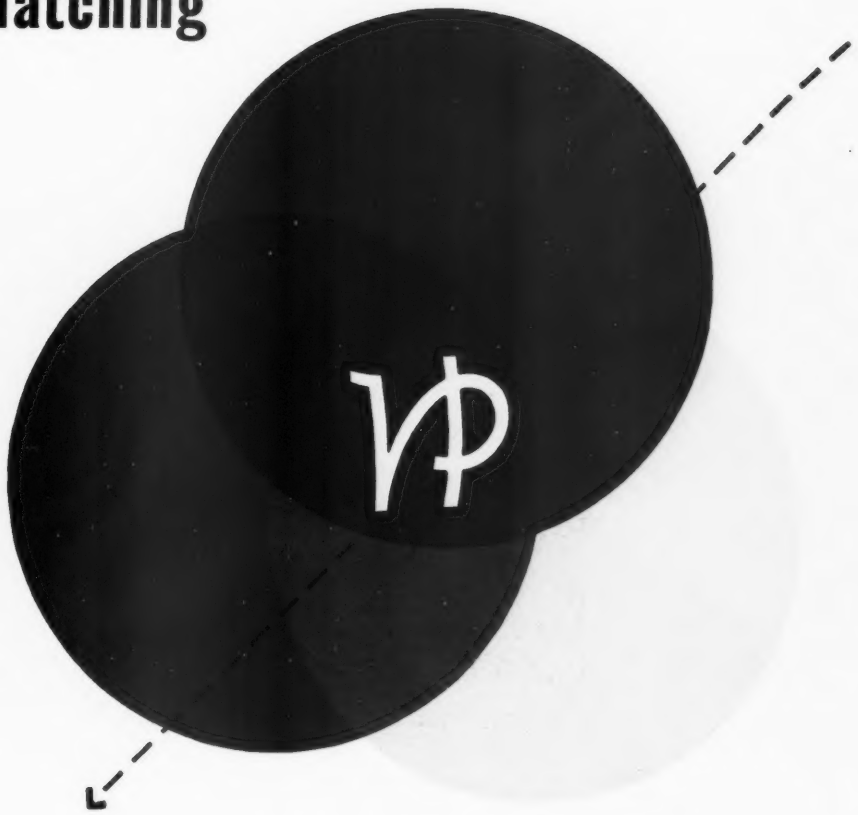

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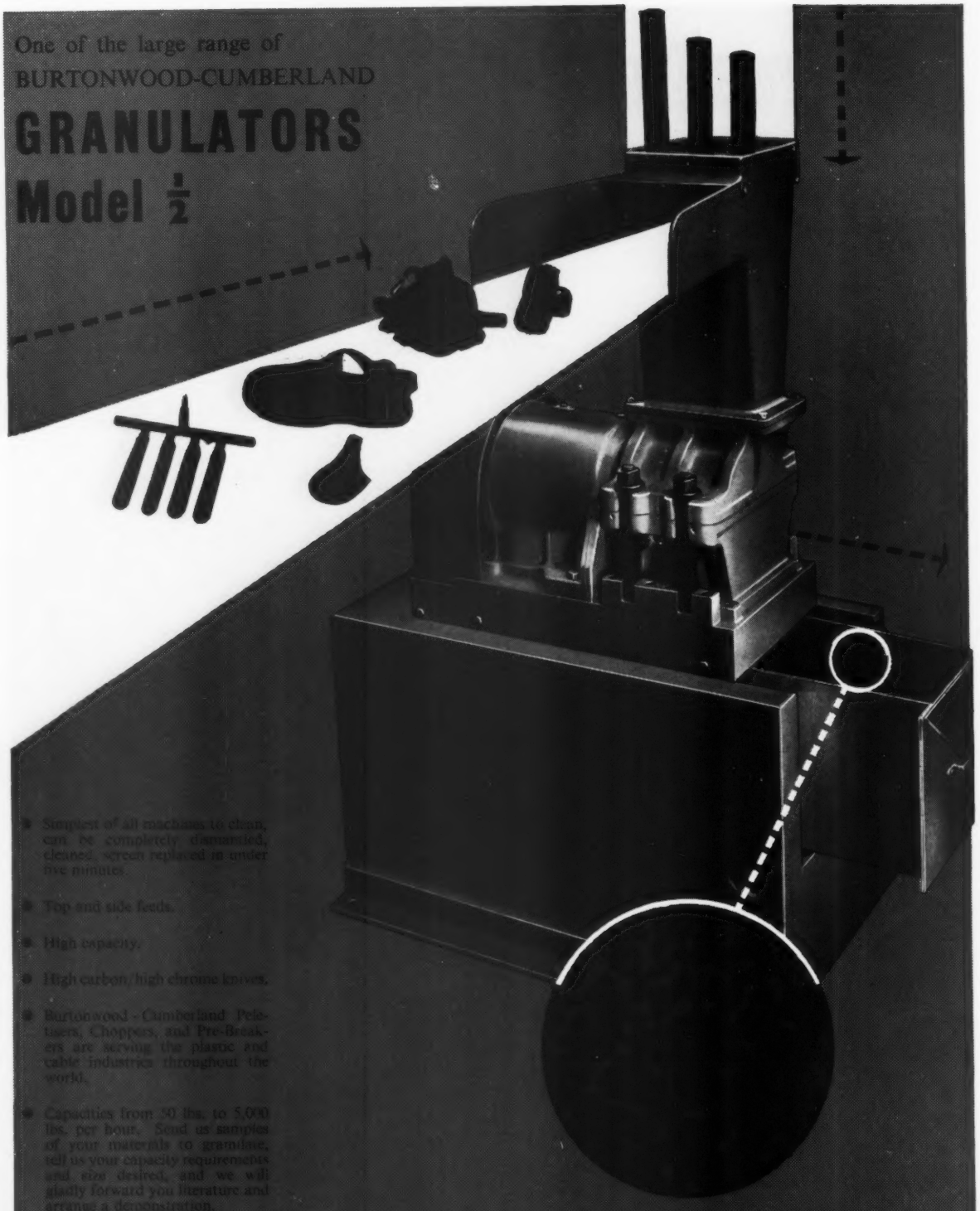
Model ½



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Case, handset and terminal block of Centenary Neophone moulded by Aldridge Plastics Ltd. for Siemens Edison Swan Ltd.

Moulded in LUSTREX

SIEMENS EDISWAN centenary NEOPHONE
The first printed circuit telephone

Siemens Edison Swan Limited chose to have the case, handset and terminal block of the Centenary Neophone moulded in Lustrex Toughened 3 — one of the many grades of Lustrex polystyrene. Here's why . . .

LUSTREX toughened polystyrene has very high resistance to breakage: the cost of replacement of moulded parts of the Centenary Neophone is considerably reduced by fewer breakages.

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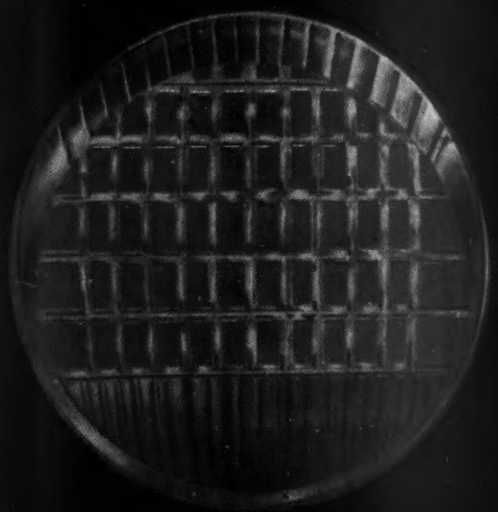

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RIGIDEX looks cleaner, feels fresher Mouldings possess exceptional surface finish. Pleasant to the touch.

PLUS ease of processing by all the usual methods.

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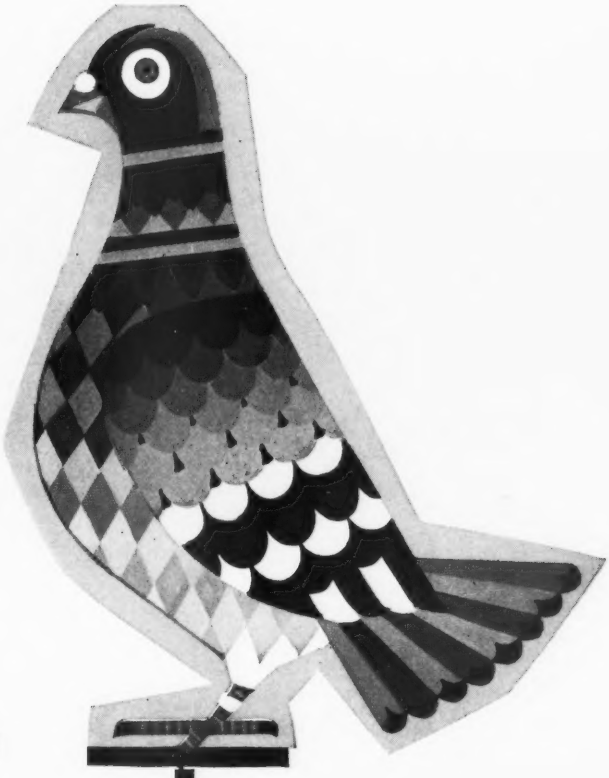

It's not our pigeon

. . . to tell people who already know, about the uses of formaldehyde. But we have every reason to puff out our chest about our quality and delivery service. We — the *first* U.K. producers — offer quick delivery of highest standard water-white formaldehyde, in any quantity, anywhere. Our service is second to none, our quality consistently high. If you are interested, write for our booklet which gives specifications of Ashworth formaldehyde and other useful information on storage, handling, etc.

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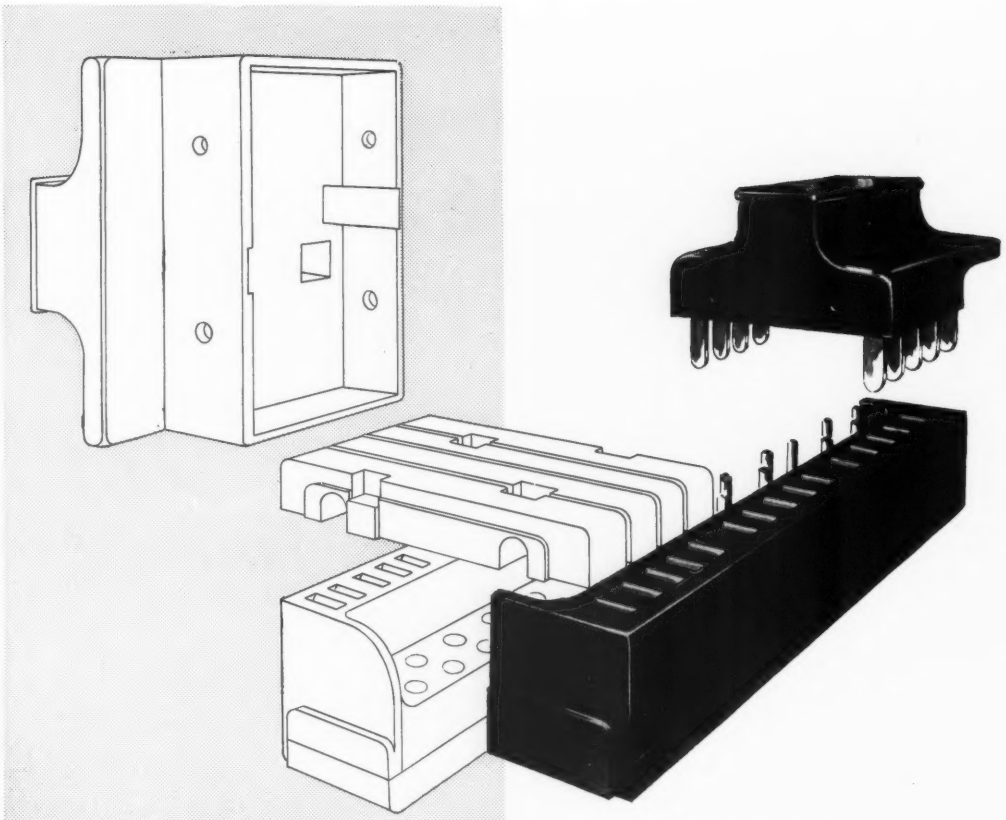

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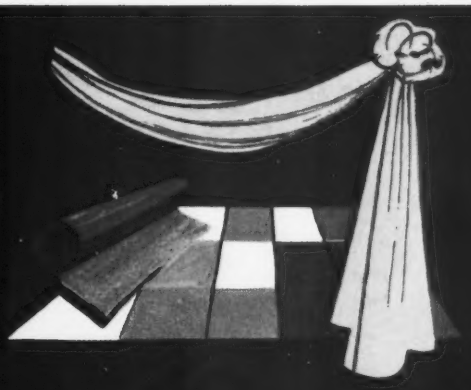

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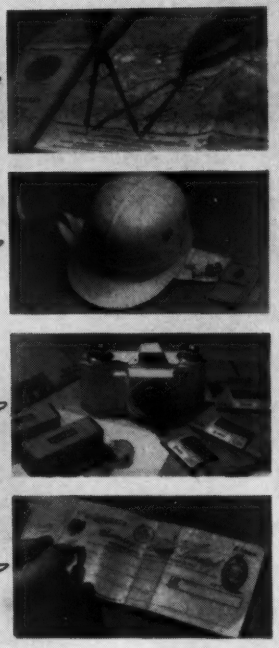

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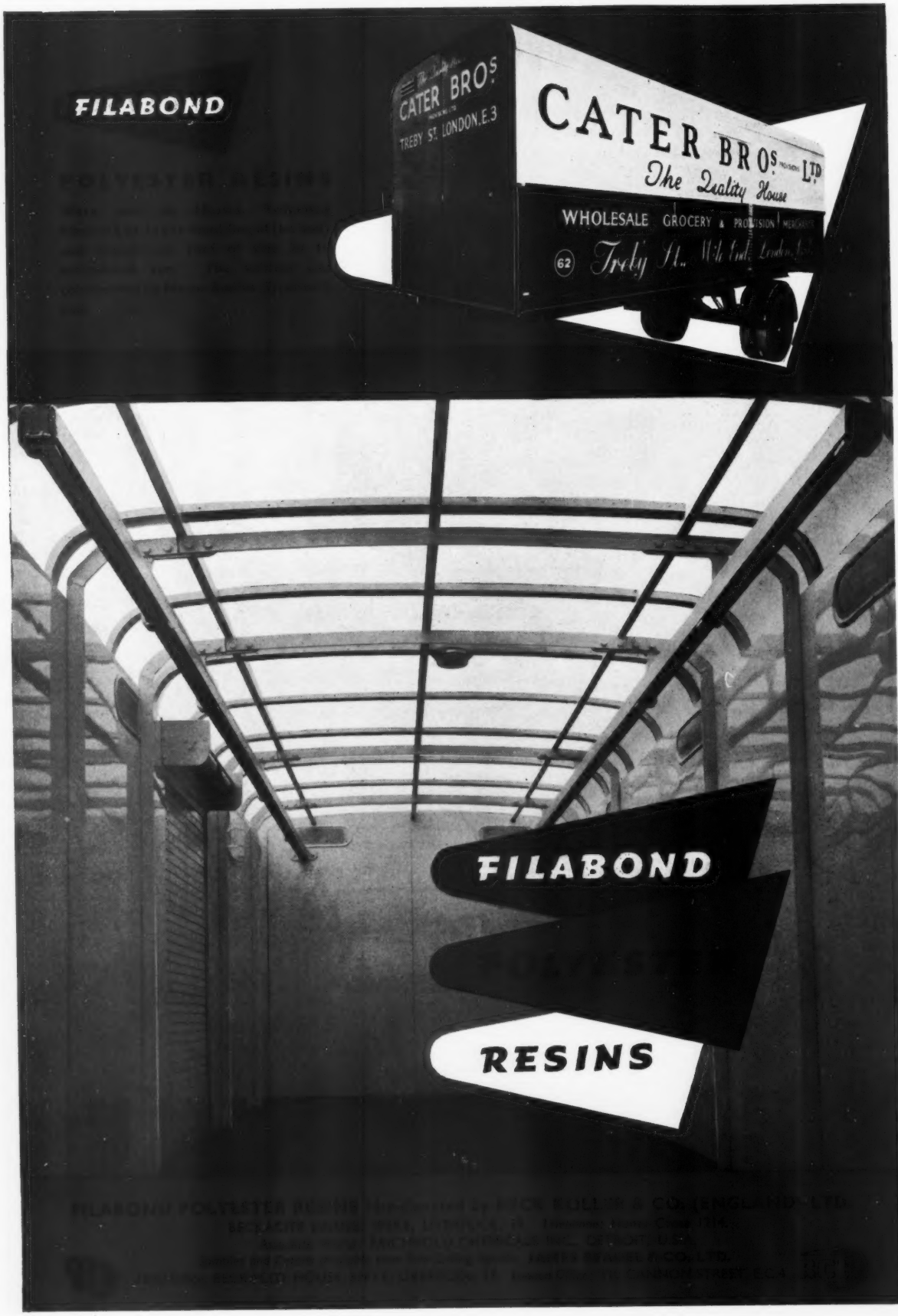
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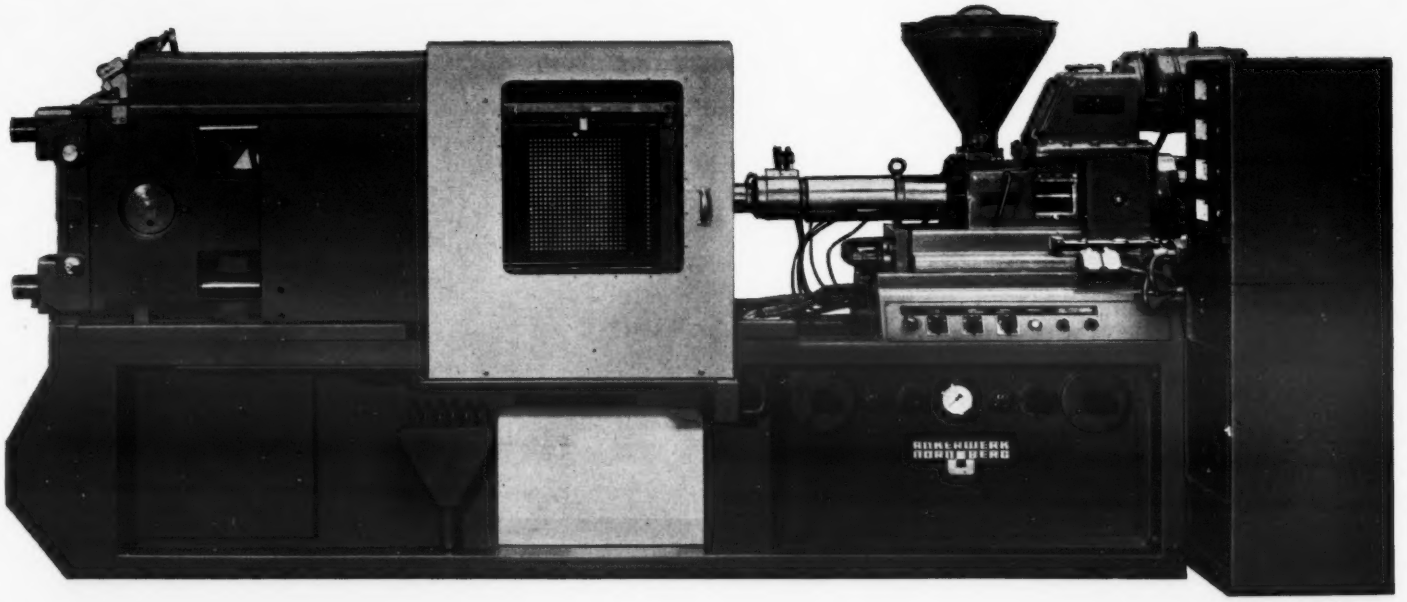

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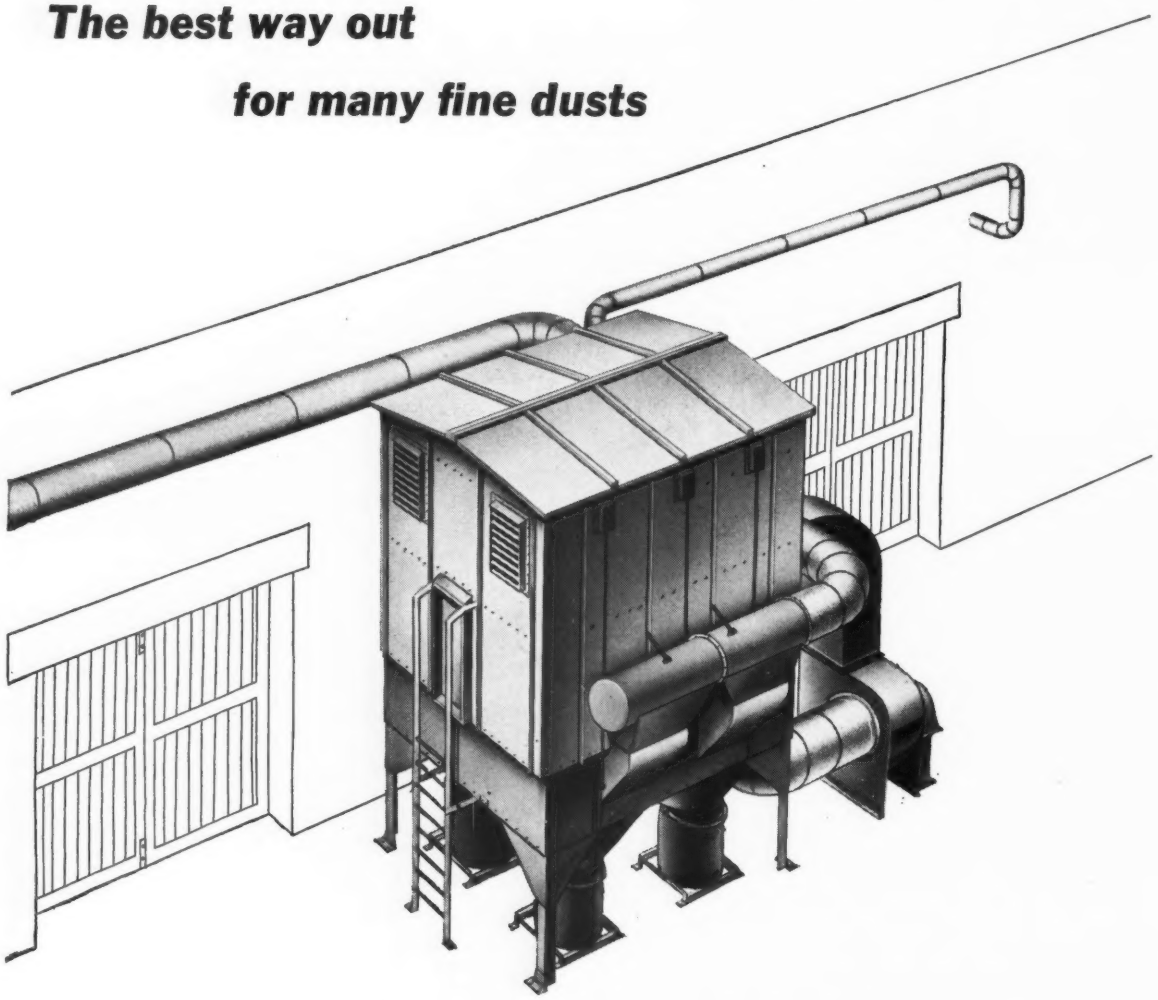

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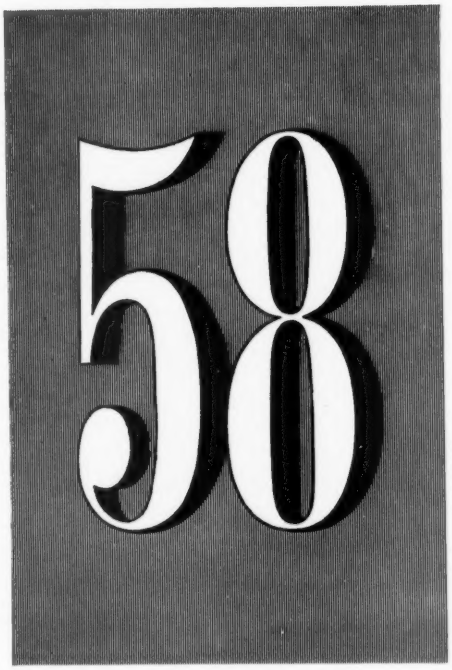

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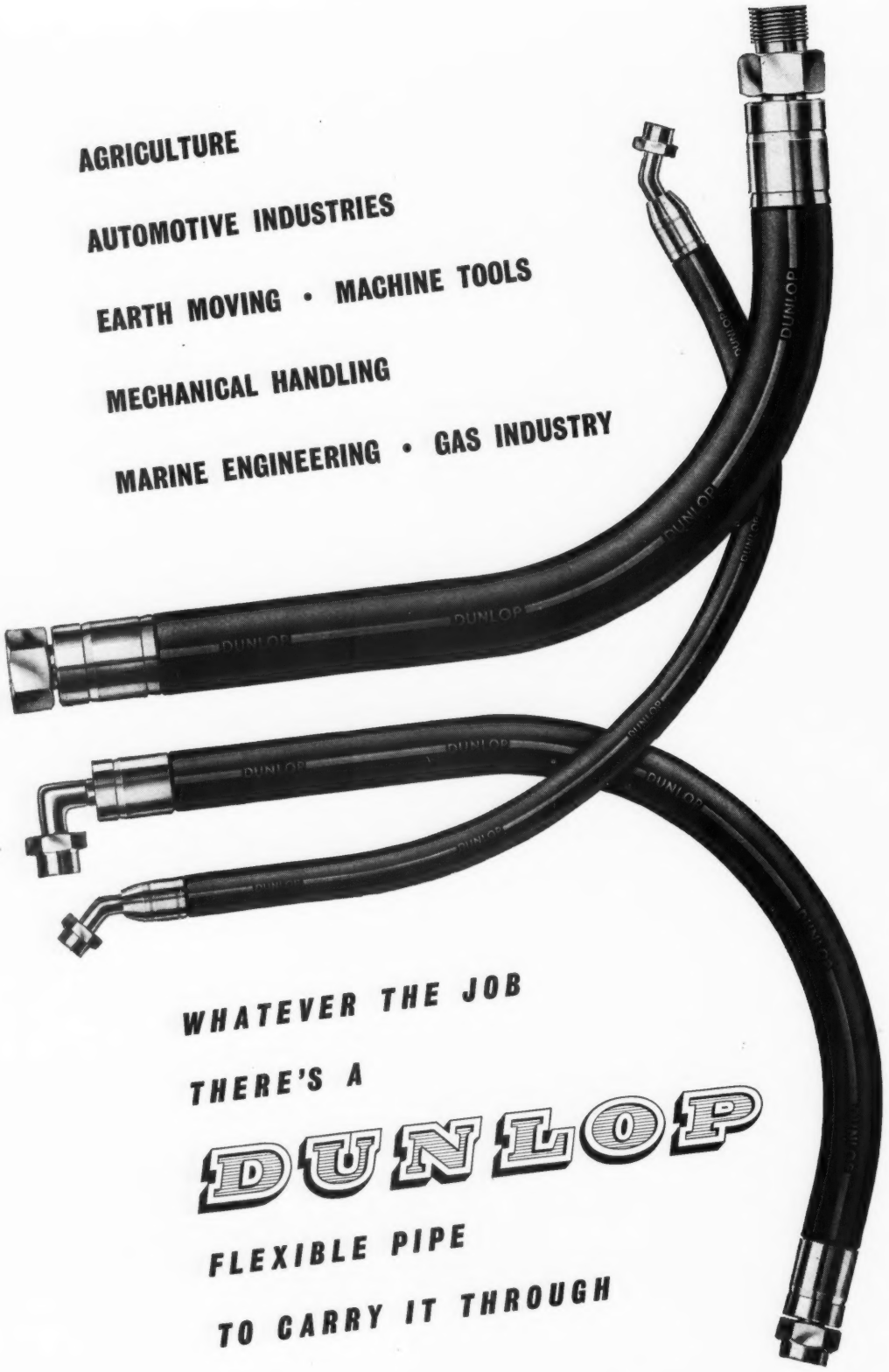

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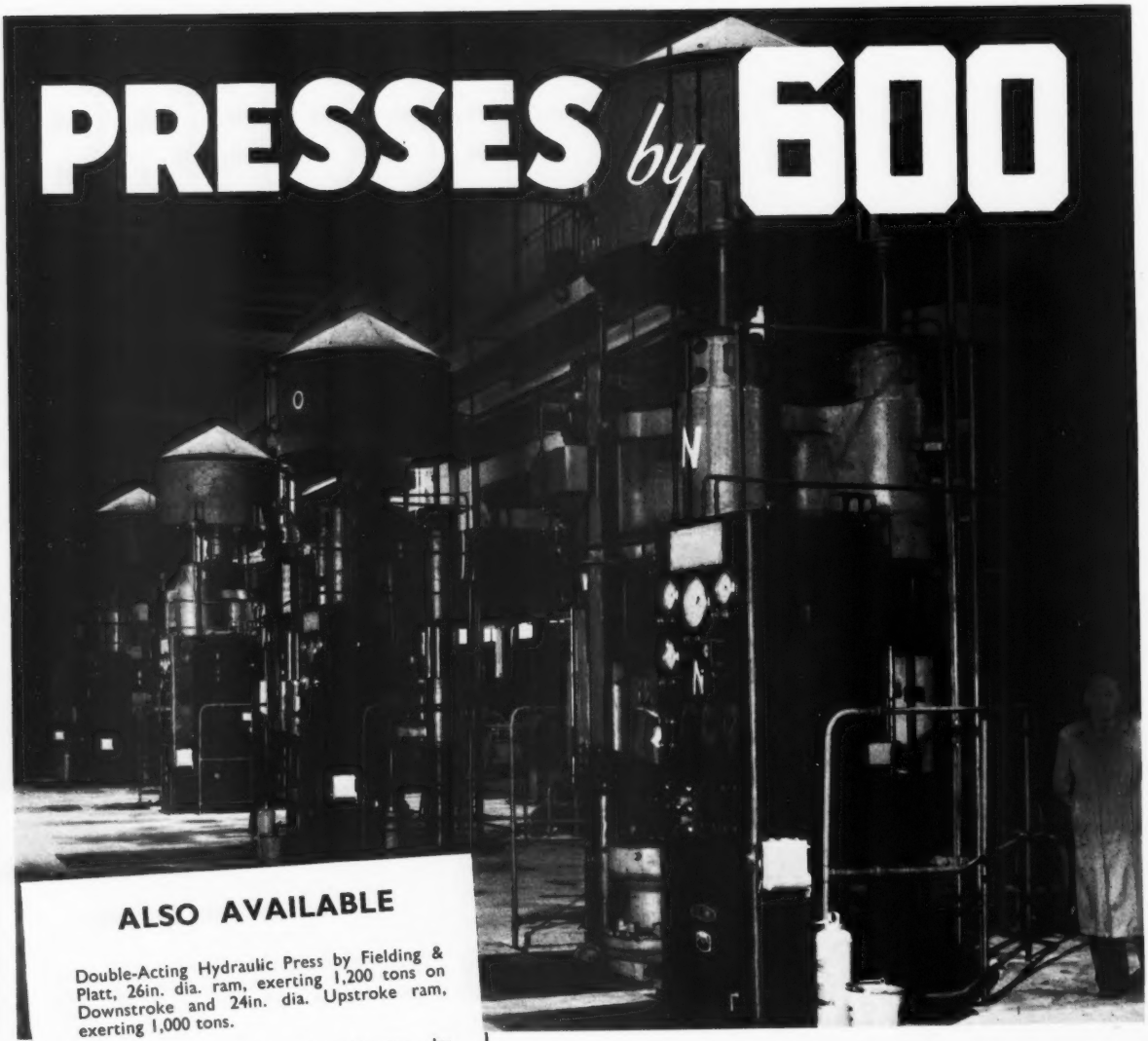

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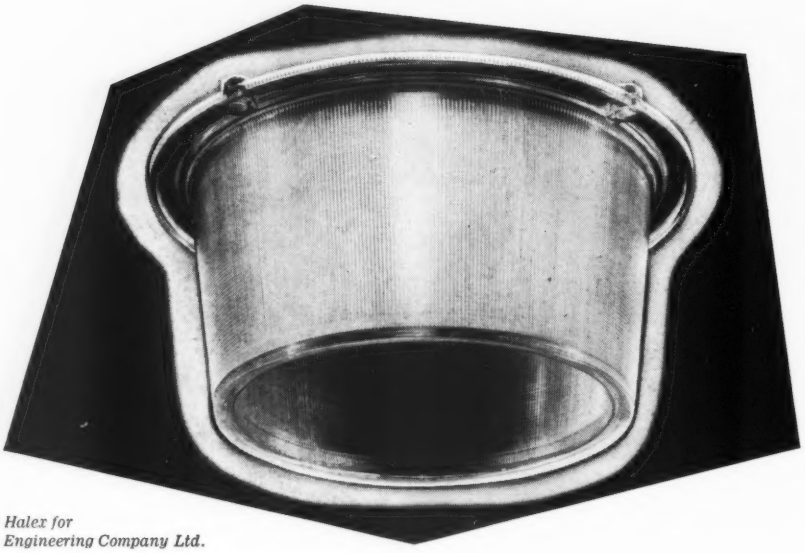

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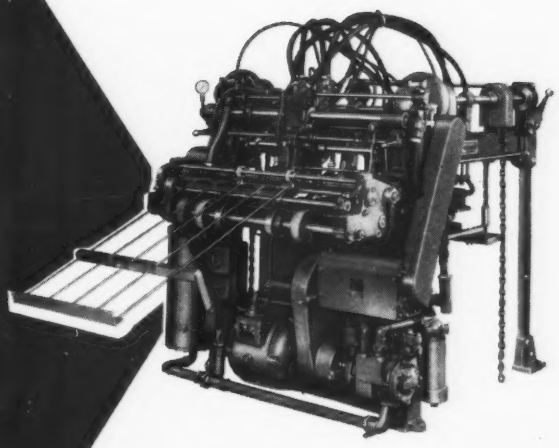

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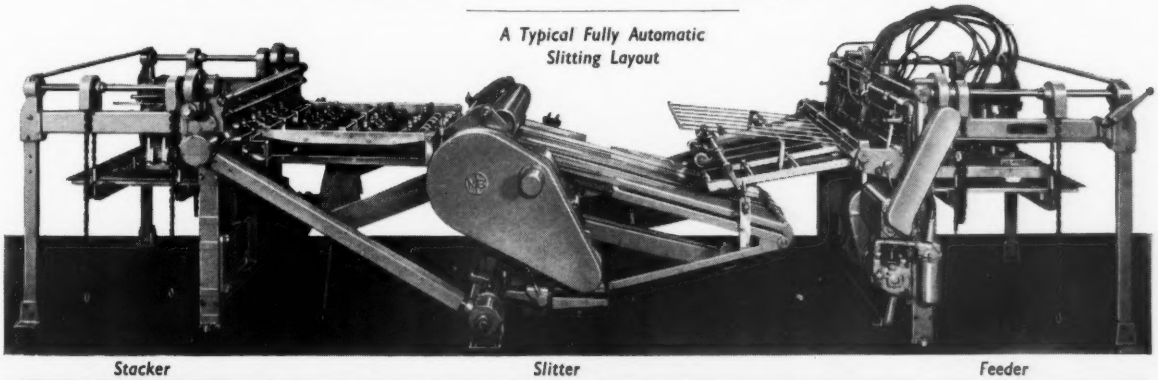

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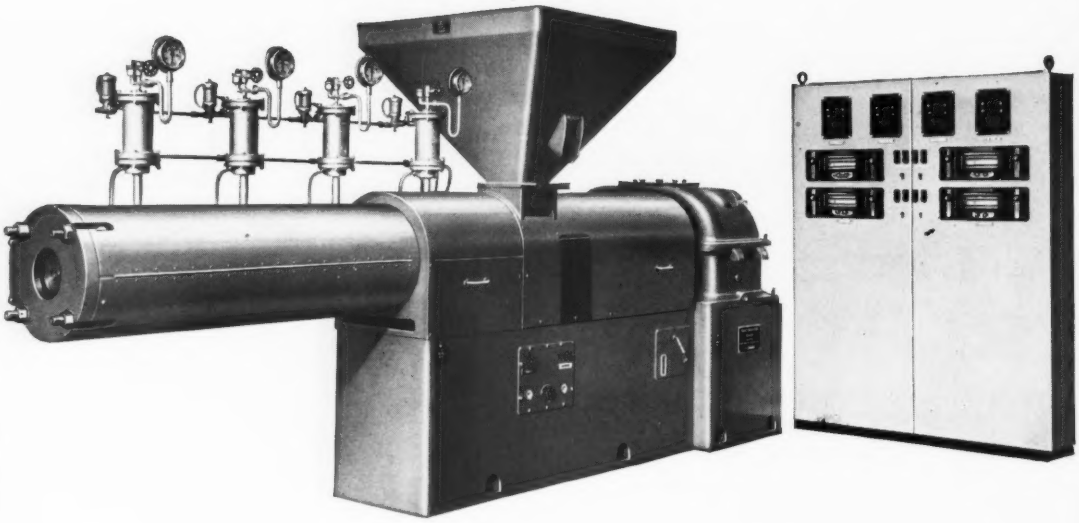

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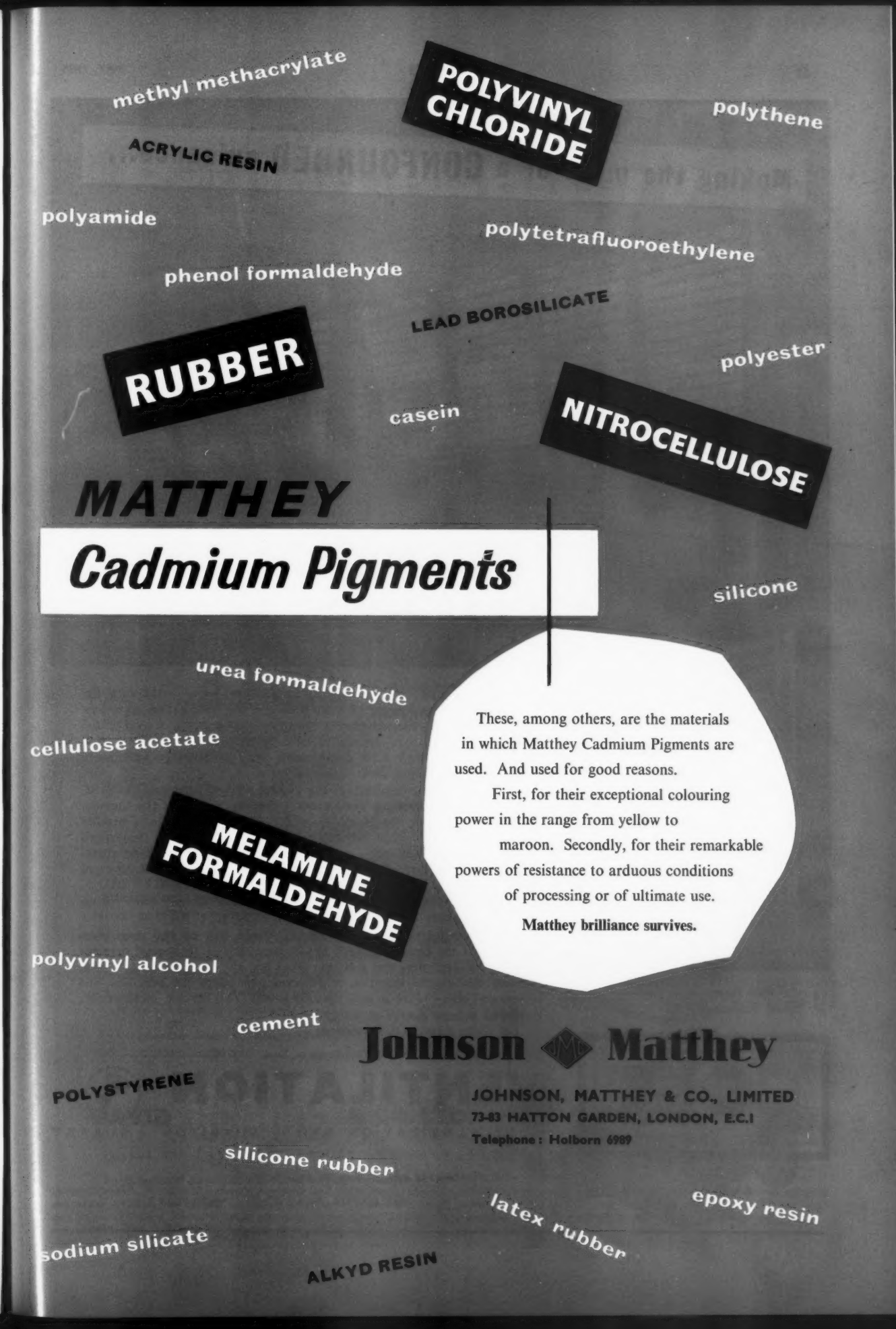
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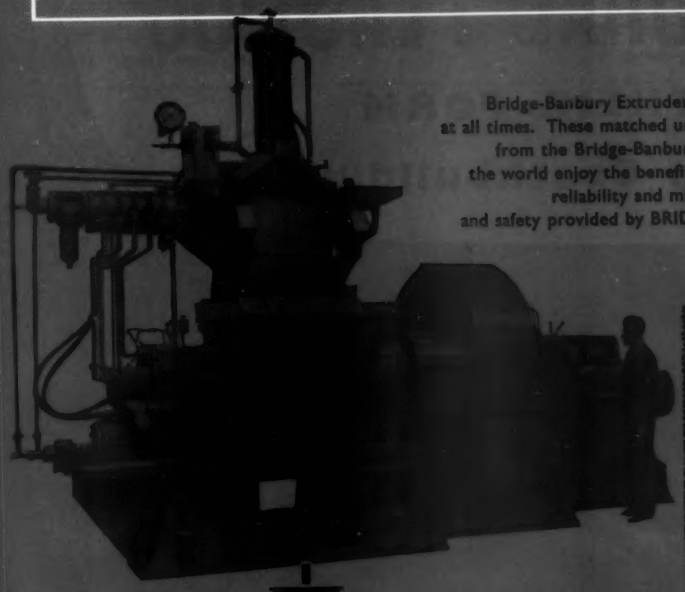

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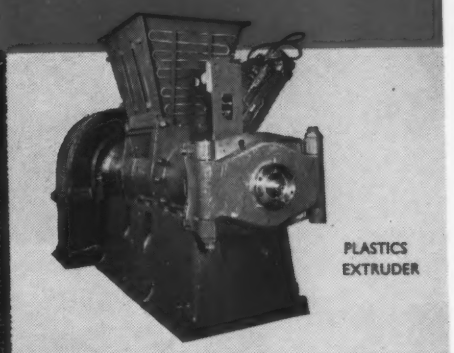

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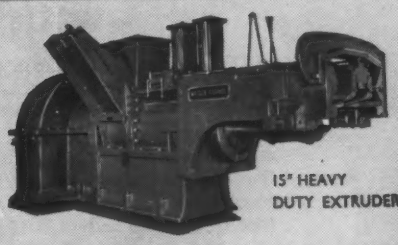

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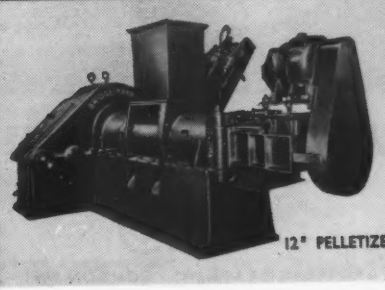

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CONTENTS

One of the assembly lines at Rovex Scale Models Ltd. A feature of the assembly is the "snap fittings" of components used in preference to adhesives.

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EDITOR: M. D. CURWEN, B.Sc., F.R.I.C.
ASSISTANT EDITOR: C. W. WELCH

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Plastics

VOL. XXIII No. 248 MAY, 1958

EDITORIALS

Science and Industry

TO the moulder of plastics materials the deliberations of the polymer chemists and physicists working in research centres throughout the world may appear far removed from day-to-day matters. By the time the results of a successful piece of research, chemical or physical, reaches the factory floor, it has been stripped of its academic paraphenalia, and has been reduced to the simpler technical terms. More often than not, so far as the moulder is concerned the information merely consists of " to get best results, do this or do that " with the machine. Whilst this may be enough for many workers, others we are sure would like to know the why and the wherefore in simple terms, but we also well know that the language of fundamental science is one of the most difficult to translate.

To us an excellent example of polymer research which would benefit moulders were it translated into " the why and wherefore " in " readable English " was the occasion of the Silver Jubilee Symposium of the Plastics and Polymer Group of the S.C.I. recently. Since the polymers discussed were those that have appeared in recent years to astound the whole world as much, shall we say, as did Brearley's discovery of stainless steel in the world of metals, and have had the effect of opening up vista's of new markets hitherto considered quite beyond the ideas of even 1945, it must surely be worth while imparting the information.

Outstanding among the papers, perhaps, was the contribution by Dr. C. W. Bunn, of I.C.I.'s Plastics Division. He has been concerned with the occurrence of crystallinity in polymers and the influence of the crystalline state on properties. His work has thrown light on many aspects of plastics technology, and his researches, with those of his co-workers throughout the world, will materially affect the moulder, the extruder and all who handle plastics, both in the fabricating stage, and at the point of use. Crystallinity in a plastic material has certain effects upon appearance and properties, effects which make a comparison with an amorphous material simple. For example, amorphous rubber is transparent, soft and flexible, whereas partially crystalline rubber (synthetic, made from isoprene) is opaque and much stiffer. Partial crystallinity can occur in natural rubber after long storage. The degree of stiffness increases generally with increasing crystallinity.

The ability of a material to crystallize depends upon the configuration of the molecule. Generally speaking, the molecules that crystallize are those with a geometrically regular structure, the degree of crystallinity being most marked in those polymers with the shortest chemical repeating units, such as the theoretical " ideal " polythene and polytetrafluoroethylene. In such cases up to 90% of the mass can be in the crystalline state. Where the geometry of the molecule is irregular, such as polymer chains with side chains randomly disposed, the amorphous state is found.

Why is crystallinity of importance to the fabricator of plastics ? The first property affected by the presence of crystallization in a material is stiffness. It might be thought therefore that normal polystyrene, a stiff material, would be crystalline. In fact it is amorphous, hence its transparency, and amorphous polymers are either hard and glass-like or soft and rubber-like depending on whether the glass-rubber transition temperature is above or below room temperature. The stiffness of the *crystalline* plastics is associated with a much higher melting point than the softening point of the same polymer in the amorphous state, and for many applications the presence of an appreciable amount of crystalline matter in a plastics material is highly important. It is possible, however, to have a crystalline polymer with a lower melting point than an amorphous polymer. The fuller appreciation of crystallinity, made possible by the work of Bunn and others, explains the interest in the discoveries of Ziegler and Natta who, by examination of catalyst structures, have produced examples of highly crystalline polymers formerly only available as mainly amorphous materials. Polystyrene, when polymerized by a free-radical catalyst, as has been the case since it was first developed, is an amorphous material with a relatively low softening point. Professor Natta has shown that by the use of co-ordinated anionic catalysts it is possible to produce a polystyrene with a high proportion of crystalline matter, in which the chain molecules are packed straight and parallel in a highly ordered manner, with a density considerably higher than in the amorphous regions. This " isotactic " polystyrene is characterized by a melting point in the region of 230° C.

Similarly, polythene and polypropylene manufactured according to anionic catalytic systems contain high proportions of crystalline matter, and are therefore stiffer and more heat resistant than would be the case were they predominantly amorphous. The comparison is clearly seen between the low density polythenes and the high density, highly crystalline versions. It is therefore clear that the ability to measure and control crystallinity in polymers produced by catalyst systems noted above, is of fundamental importance, permitting in the fullest sense of the word the " tailoring " of the molecule or plastic to meet specific ranges of applications.

Quenching

We shall also hear more in the future of work touched upon by Ir. P. W. O. Wijga in his contribution to the Symposium, the influence of quenching upon the properties of crystalline materials, specifically polypropylene.

Reporting on work carried out at the Shell Laboratories, Amsterdam, he showed that quenching can influence the dimensions of the crystal structure, giving micro-crystals as distinct from the larger spherulites formed when samples of polypropylene are cooled slowly. The average degree of crystallinity is hardly affected by the rate of cooling.

The importance of this work may be judged by some figures he gave: a slowly cooled sample had an elongation at break of less than 20%, a tensile strength of 257 kg./cm², and a zero flex resistance. The same material, polypropylene, rapidly quenched from 240° to 10° C. possessed an elongation at break of 60%, a tensile strength of 304 kg./cm², and a flex resistance of over 2,000.

We are adding refinement to refinement, and each month sees a new development, sometimes large, and sometimes small, which extends our knowledge of plastics materials and their behaviour. When we have solved some of the problems of fabrication, and when we have refined those processes we use today, we shall be able to take full advantage of the work of the chemists and physicists the world over.

Moulders Worry

IT does not need much prescience to realize how important crystallinity and amorphousness is to the moulder in his very business. For clarity and transparency has long been the essence of part of it, not only in the optical field as camera and spectacle lenses and prisms, but also many desirable technical and non-technical productions, aircraft windscreens and turrets, toys, surgical instruments, window displays, " jewellery," food-covers, lighting fixtures and the hundred-and-one units and components that have appeared during the past 70 years or more since celluloid first appeared.

It was with no facetiousness but with real concern that we were recently asked: " If all the new stiffer high temperature resistant thermoplastics cannot but be opaque, what is the future of the lower strength plastics which we use because of their transparency ? Will they gradually disappear ? And why can't we have transparent high temperature resistant thermoplastics ? "

To deal with the last question first, the answer is given on the previous page. Generally " low strength " types are amorphous and the molecules are " loose," so that light is not scattered at the boundaries between crystal and crystal; the " high-resistance " type are crystalline with the molecules much more strongly bonded so that not only do they not separate and flow so easily under higher temperatures but the tightly packed " crystal " layers scatter the light instead of permitting it to pass through them. Apparently we cannot have high transparency *and* high temperature resistance in one and the same material without brittleness, at the moment.

To the first question we may reply with the obvious. If the demand exists for transparency *per se*, as it obviously will, the so-called lower strength transparent plastics will always be made however great the demand for the newer type. Some change in types used will doubtless arise, and, for example, part of the demand for general purpose polystyrene has clearly been lost with the entry of " opaque " high impact strength polystyrene made by mechanically mixing rubber with the general purpose compound.

Moulding Powder and Shot

More About Fused Silica

Over a year ago I saw a sample of fused silica " wool " made from quartz or high quality sand on the Thermal Syndicate stand at the Instrument, Electronics and Automation Exhibition. Although I had had some experience of the bulk material used as piping and condensers for the cooling of hot nitric acid and of the rare use of the filament in special electrical work (e.g. for galvanometers and high strength wire covering) this new form was quite new to me and almost new to the Thermal Syndicate. I published a note of it on this page in the June, 1957, issue, suggesting that it might be worthwhile examining for use in modern resin laminates, claiming a higher Young's Modulus for it than glass fibre. I was therefore very intrigued to read a summary of a paper entitled " Polymers for High Temperature Service " by Brenner and Morsell of New York University and presented at the Canadian–U.S. Chemical Engineering Conference in Montreal on April 20, 1958, which described a new material "Astrolite," a " silicate " fibre (96% SiO_2) reinforced phenolic resin laminate which can resist temperatures up to 10,000° F. (5,500 °C.) for short periods. Such laminates have been produced for missile noses, etc., and appear to possess nearly double the resistance of both glass and asbestos and can easily " outperform " steel plate. I presume the word " silicate " used above is a misprint for " silica " (since no silicate contains as much as 96% silica) and that it refers to the type of fused quartz or sand fibre I saw at the aforementioned exhibition. I have heard that " Astrolite " is now being made in this country by British Refrasil Co., Ltd., of Stillington, Co. Durham.

* * *

Out! Damned Symbol

Long, long ago when I was doing a fairly honest job of work in Mexico, I found that it was common among most grades of workers to use the symbol # for " number." Thus " Sample No. 1 " became " Sample # 1 " and so on. Perforce, I used the same symbol myself when issuing orders or reports to Mexicans without ever discovering its origin, but I also noted its use for the same purpose in some parts of the U.S.A. To my astonishment when reading the above mentioned report of the Canadian–U.S. Chemical Engineering Conference, I again noted its use; this, to say the least, is unusual for an important technical and scientific publication. What is worse, it was employed in the same paper for more than one meaning. Thus, on one page, reference was made to Fig. # 4, another contained the expression " On a weight basis this is equivalent to 1 # of Astrolite outperforming 15 # of steel " (using the symbol to mean " pound ") and yet again " single pieces weighing as much as 50,000 # each" adjacent to tables liberally sprinkled with " p.s.i. " and " lb. sq. in." Really ! At a time when we are trying to achieve international understanding and standards and to put our English-speaking technical houses in order, this is an excellent example of how not to do it. I wonder what my old friend, Dr. Gordon Kline of the U.S. Bureau of Standards, thinks?

* * *

Examination Question

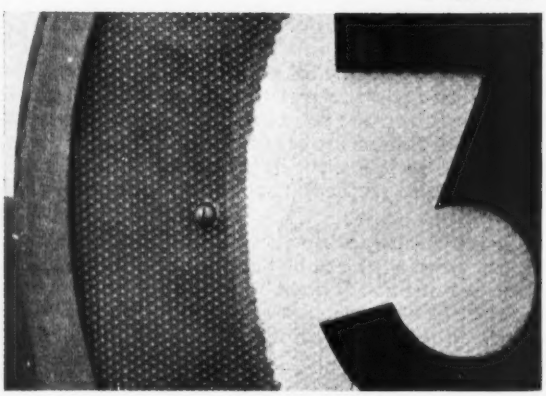
Who and on what occasion, wrote: " To what purpose, we say, is a bird placed in the woods of Cayenne with a bill a yard long, making a noise like a puppy dog, and laying eggs in hollow trees? The toucan, to be sure, might retort, to what purpose were the gentlemen in Bond Street created ? To what purpose were certain foolish prating Members of Parliament created, pestering the House of Commons with their ignorance and folly, and impeding the business of the country ? There is no end to such questions." Comment zoomorphologically and sociologically on the first question, on the solecism in the second, and in the modern political analogy of the last question.

* * *

Diakon Speed Limit Sign

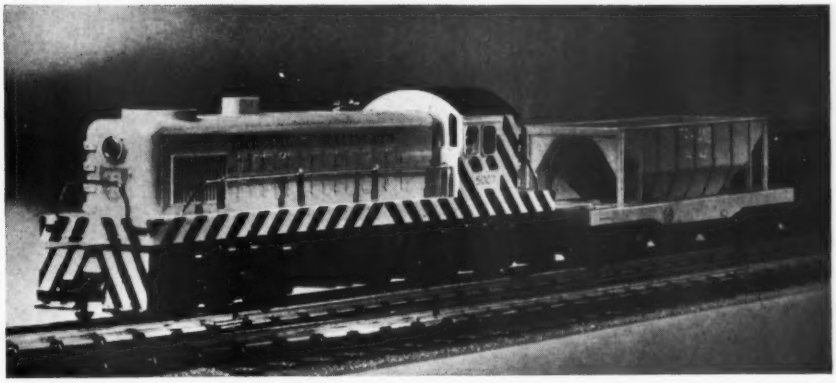
Several readers of the editorial note published last month of a 1937 moulding in Diakon shown at the April, 1938, British Industries Fair, have asked for further information on this production. I am therefore reprinting herewith the photograph I took on that occasion of the 30-mile-an-hour limit sign moulded by Ebonestos Ltd. The basic disc consists of 17,000 " lenses " which actually act as reflectors, the whole being moulded as one piece from transparent " Diakon " acrylic resin moulding powder. The dark circular surround is red to secure greater visibility and obviously was sprayed on the base plastic.

DOGSBODDY.



This train she runs to Quincy,
Monroe, and Mexico,
She runs to Kansas City, and
she's never running slow;
She runs right into Denver, and
she makes an awful squall.
They all know by that whistle
it's the Wabash Cannonball.

Now listen to her rumble, now
listen to her roar,
As she echoes down the valley
and tears along the shore.
Now hear the engine's whistle
and her mighty hoboe's call
As we ride the rods and brake-
beams on the Wabash
*Cannonball.**



Plastics and Model Railroading

THE second most popular hobby in the Western World today is model railroading. The first, incidentally, is philately. On this premise we feel that attention should be drawn to the important part plastics are playing in providing this large market with the items which these enthusiasts demand.

One of the largest manufacturers of model railways in the world is Rovex Scale Models Ltd., who produce the familiar Tri-ang Railways. The sole output of this company is model railways and the ancillary equipment which goes to make up a realistic layout, and in this respect they are one of the leading factories in the world which are thus solely employed.

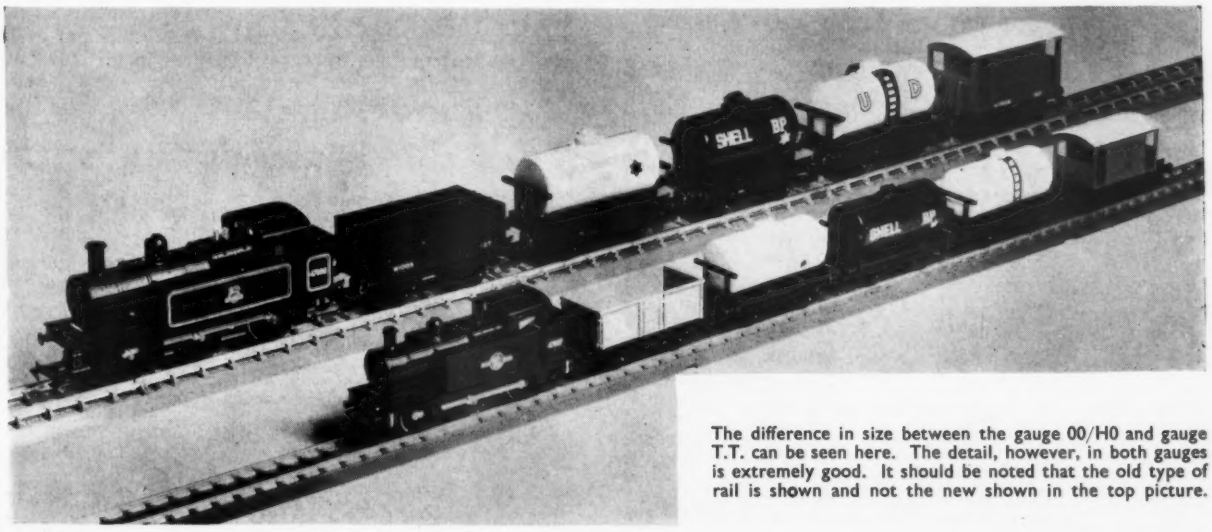
Three equal factors govern the appeal of any model no matter whether it be a railway, ship or road vehicle: Realism, price, and working reliability. The intelligent use of plastics has helped considerably to provide a combination of these factors which has proved more than acceptable to the most discerning and exacting enthusiast. The accompanying photographs give some idea of the accurate reproduction which is obtained and we shall in the following article discuss some of the problems involved both in the production of the models and in the organization of the factory. These problems, we feel, are not confined to the moulder of model railways and are therefore relevant to the moulding and fabricating side of the plastics industry as a whole. It is in this belief that we publish one company's solution to them.

* Extracted from " The Wabash Cannonball "—printed in The Hobo's Hornbook by George Milburn.

Development

Rovex produce two model gauges, the OO/HO which is an 80: 1 scale reduction and the T.T. which is equivalent to 3 mm. to 1 ft. The illustrations in this article cover both gauges.

Any model produced, starts from the blueprints of the original component or unit. These are carefully studied by the development personnel and a true visual model is made up. Such a model is necessary as in some cases this model looks out of proportion due to the difference in position of the observer's eye when looking at the model and looking at the full size original. Modifications are, however, kept to a minimum conducive with appearance. From the visual model a set of fully detailed component drawings are prepared and a second model built to these drawings. When this is approved work is commenced on the moulding tools and at the same time designs made for paint spray masks, assembly jigs and tools, and punch tools for any metal components. A provisional assembly line plan is also prepared and any special materials ordered. When the model eventually comes on to the production schedule (some 12 months after the decision to produce it has been made) it is closely



The difference in size between the gauge 00/H0 and gauge T.T. can be seen here. The detail, however, in both gauges is extremely good. It should be noted that the old type of rail is shown and not the new shown in the top picture.

(Right) In the toolroom skilled toolmakers manufacture the moulds and jigs which often involve a considerable amount of bench work.

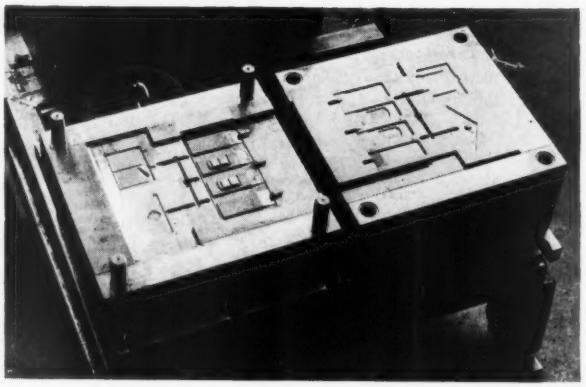
studied throughout the assembly stages so that any problems can be resolved with the minimum of delay.

Moulds and Jigs

The secret, if it can so be called, of model production using injection moulded plastics lies in mould design and workmanship. Only by using moulds of the highest quality and not overloading the machine can clean accurate mouldings of the necessary quality be produced. Most moulds used by Rovex are designed and produced in their own factory and the greatest care is taken in their manufacture and also in their maintenance. The design of these injection moulds presents several problems, one of which is gating. For obvious reasons the gate should be in the least obvious position and also of the smallest size. Pin gating has solved some of these problems and it is extensively employed. A second problem is undercutting, which is often necessary to reduce the number of mouldings required for a model. Split moulds provide the solution here and several complex tools of this type are in operation. Besides the actual injection moulds a considerable number of assembly and spray jigs are used on the production lines and these also must be constructed with the greatest care.

Materials

The materials used for moulding are cellulose acetate and high impact polystyrene. The improvement in these materials, particularly in the polystyrene, has meant improvement in the designs of various parts. This is particularly noticeable in the track where it is now possible to mould a realistic sleeper construction for the base instead of the old solid construction. Heightened realism is achieved by laying the track on a grey polyurethane foam strip which gives the appearance of ballast. Improvements have also been made in rolling stock, design and buildings by using in their assembly the inherent resilience of the material. In this way the majority of the cementing operations have been replaced by " springing " the parts into position where

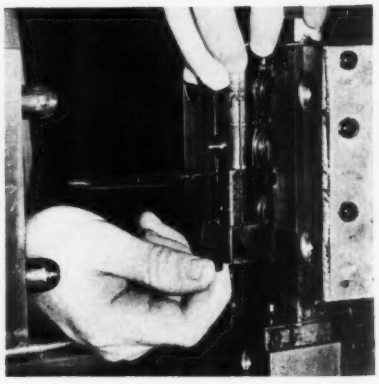


Pin-gated mould for the 00 gauge engine shed and hoarding.

they are held by lugs or clips. This not only results in a much cleaner product and simpler assembly but also emphasizes the necessity for top quality mouldings. Other methods of fixing employed are principally mechanical and eyeletting is a favoured method.

It is worth taking a closer look at this problem of assembly

(Left) Vertical milling the under frame for T.T. Bogie Bolster Waggon.



(Right) Extracting a body moulding of an 0-6-0 tender locomotive.

The injection moulding shop which presents at all times the tidy appearance shown here.

because it involves more than would appear at first glance. Three methods can be employed; solvent welding or cementing; interlocking, and mechanical fixing by screw, eyelets, etc. Dealing with the solvent weld or cementing; this method is quick and effective but it does, however, have some drawbacks. Primarily the joint is not invisible unless very carefully done and there is also the risk that surplus solvent will be transferred from the operator's fingers to a moulding. There is also in this case the difficulty of joining two different materials.

The successful use of the interlocking technique depends both on design and material. Materials, obviously, because using an unsuitable material fracture will occur on assembly, or the lock will be too weak. But design is an even more important factor for in considering interlock fastening it may be found that the simple injection mould has to be replaced by a three-plate split mould and such additional cost has to be justified in the final product. In addition exceptional care has to be taken to ensure that the dimensional accuracy of all mouldings is kept within fine limits. The result, however, can justify the extra costs involved in that dissimilar materials are joined without any difficulty, the appearance is excellent, and a broken part can be replaced without destroying the whole assembled unit.

Finally, mechanical fastening which is excellent in certain circumstances but is limited by accessibility. It is particularly useful where swivel joints are required such as bogie assemblies, and couplings. Self-tapping screws are also valuable assembly media.

Factory Organization

To produce such a range of model railway equipment and the numerous mouldings and components that make up even one item requires factory organization of considerable efficiency. We feel that readers and moulders in particular, may be interested in this organization and how it operates.

The factory programme is divided into periods of four weeks and a schedule of what is to be produced during this period is prepared. Each department supervisor has a copy of this schedule and then knows what his or her production has to be. The supervisor can then indent to the stores for the required number of components to complete this schedule and arrange for the necessary labour to be available. It is worth noting here that the factory labour is not paid on piece work but on a flat rate so that the only incentive is the monthly production target. Each section is responsible for a complete assembly and is therefore a self-contained and self-reliant unit only dependant on the moulding shop. To ensure continuity of supply and also co-ordinate the different production rates of the moulding and assembly sections the moulding shop works a fortnight ahead of the assembly lines. Thus there is a substantial " buffer " of mouldings which enables longer runs per machine and accurate forward planning of moulding capacity. The moulding machines are predominantly those manufactured by R. H. Windsor Ltd., and Projectile and Engineering Co., Ltd. The largest machines are of 8 oz. capacity.

Export Market

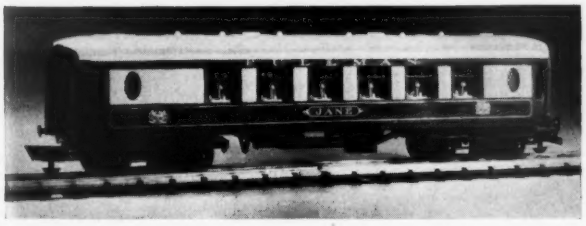
We have mentioned the extensive range of models which are manufactured by Rovex based on British Railways engines and rolling stock. There is, however, a large export business, and to cater for the Canadian and American markets several locos are now produced which are models of the transcontinental passenger and freight trains of these countries. These, like their British counterparts, are exact replicas of the original and are finding an increasing market overseas against stiff competition.

Australasia also has many enthusiasts, and Rovex models are now being produced in Australia from moulds made in Margate and shipped out there.

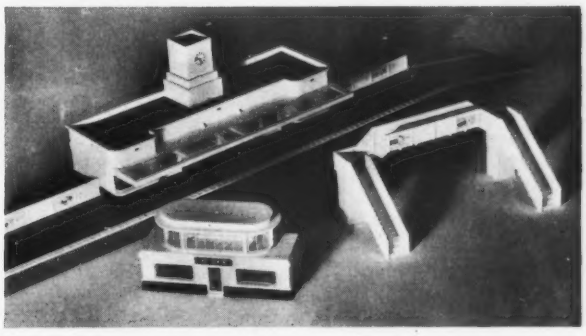
It will be apparent from the foregoing notes that the model railway business is extensive. How extensive it is can be judged by the fact that Rovex have produced over 1 million locomotives and 2,000 miles of track.

In addition Rovex are now producing clockwork operated models for the beginner who may find the initial outlay on transformers, etc., rather heavy. As the track is the same, later conversion to electric can easily be effected.

In conclusion we should like to acknowledge the co-operation we have received from the directors and staff of Rovex in preparing this report.



(Above) Accurate reproduction of detail is clearly seen in this Pullman coach.



(Right) T.T. gauge track-side buildings which like all the models have an authentic appearance.

Epoxy Resins for Moulds and Dies

A NEW development in the production of glass fibre motor car bodywork has recently been introduced by Jensen Motors Ltd. at their West Bromwich factory in the manufacture of their famous sports saloons.

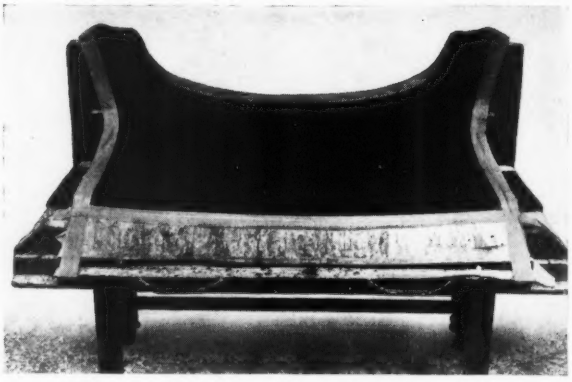
The standard method of producing bodywork sections is to lay-up sheets of glass fibre mat in a suitably shaped mould, impregnate with polyester resin and cure in an oven.

Originally the moulds were also made by Jensens from glass fibre-reinforced polyester resins but in practice these were found to have a number of disadvantages. The mould edges proved brittle and needed frequent repair. The moulds were not sufficiently rigid and even with strong backing reinforcement they tended to warp after being used a few times. A further disadvantage was that cracking or crazing on the surface of the moulds made the release of cured body sections a difficult job as well as tending to give a poor finish.

Having decided that epoxy resins might be better for this job, Jensens made an experimental mould using Epikote 815 resin cured with Epikure T and reinforced with glass fibre.

Over 200 roof sections have been produced from this original mould which even now shows no sign of warping or of surface cracking.

With a coating of p.v.a. release agent, the smooth hard surface gives excellent release characteristics and a laminate with an excellent finish. The extra toughness of the resins used has virtually eliminated the need for repairing the mould edges.



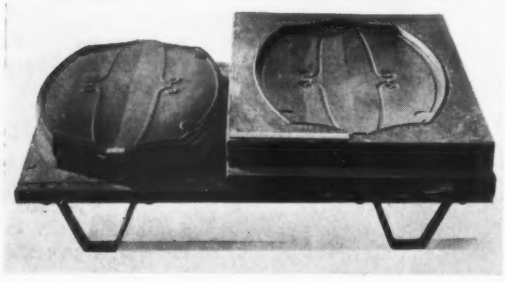
Epikote resin mould used for forming polyester/glass laminated car body sections.

Metal Forming Dies

Besides the use of these resins for low pressure moulds as described in the previous paragraphs they are used extensively as dies for metal forming. A recent development in this field was reported from Union Carbide's Bakelite Co. in the U.S.A., who announced the introduction of a new material and process, Epoxy-Alloy. This consists basically of a heat resistant epoxy resin reinforced with either low carbon steel fibres, aluminium fibres or a combination of glass and steel fibres. To obtain the best surface finish the casting must have an epoxy coating reinforced by chopped metal fibres which in addition to adding strength gives a highly abrasive resistant surface.

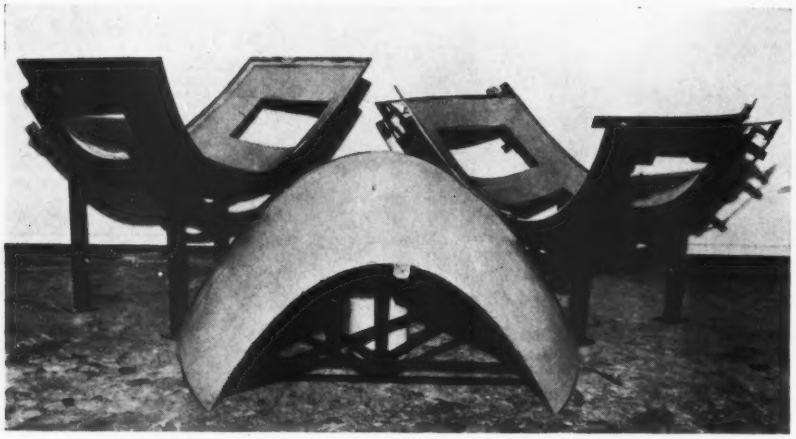
By using metal fibres a reduction in shrinkage and brittleness is effected and in addition the operating temperature is increased to at least 350° F. A further property, that of thermal conductivity, is improved by as much as 60 times.

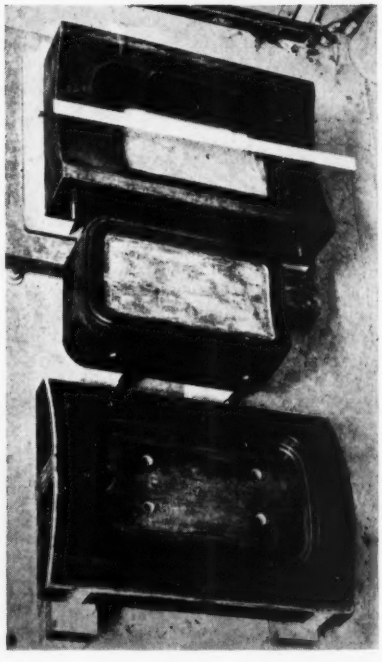
As proof of their durability two cases are quoted. Borg-Warner have produced over 130,000 stampings in 0.025 in. brass and Hotpoint have produced over 65,000 refrigerator panels from 0.035 in. cold rolled steel. Considerable reduction in costs and production time as compared to cast aluminium or steel dies make the use of epoxy dies an economical proposition in many cases for metal forming.



(Left) A punch and die for pressing out the two sides of a doll's pram in 22 gauge mild steel. The tools are made from Bakelite epoxy resin.

(Below) Radome tools in Epocast epoxy resin made by Goodyear Aircraft Co. Left is the drill jig, centre the "model" and right the trim fixture.





Araldite draw die set. The rule shown is 8 ft. long.

The Future of Glass-Reinforced Plastics

By J. H. COLLINS, B.Sc., F.R.I.C.*

Reviewing progress to date, the author outlines his conception of the trend of developments in this branch of the industry in the near future

NO other group of plastics materials has had such a difficult period of birth and development as the combination of thermosetting resins with glass fibre reinforcement. It is now 15 years since the first resins were introduced which could be thermohardened by cross linking through unsaturated groups instead of the conventional condensation methods and thus opened up the possibility of no pressure moulding processes. For a long time the development of them commercially hung fire and the promised revolution in the plastics industry did not materialize. Then the combination of the newly developed fibres of glass with resins made from glycol and the unsaturated maleic or fumaric acids using monostyrene as a cross linking agent hit the headlines of publicity and there was born almost overnight a new section of the industry. Plastic moulding without presses had arrived. The size of the moulding had ceased to be a limitation, motor car bodies and boats were just asking to be produced. Having barely emerged from a period just after the war when the prestige of the industry sank low with the badly designed mouldings and the unsatisfactory fabric " substitutes " we were soon into another age of trouble with products and producers failing to survive and give good service to the community. Once again scores of people fell into the trap of thinking that here was the easy solution to their problems and they found their errors to their cost. Painfully the resin glass industry has become established and worthwhile products are now being put into useful service. It may be profitable to review the failures and the successes with the object of forecasting the way in which this new family of plastics materials will develop in the future.

Although in the immediate pre-war years a coffin was moulded in phenolic material, the practical limits of all conventional forms of moulding has never really been larger than the domestic radio cabinet or large washing up bowl. This has partly been governed by the size and the cost of the machinery and partly by the flow properties of the moulding materials. Apparently the limit of size controlling polyester glass fibre products is only that of organizing hand labour to lay up the moulding within the curing time of the particular resin mix. Thus complete caravan bodies and 40-ft. power driven boats have been produced to the satisfaction of maker and user. However, many more caravans and boats have been produced to the satisfaction of neither. To date it is difficult to find either material supplier or moulder who will admit to having made financial profit from glass fibre plastics.

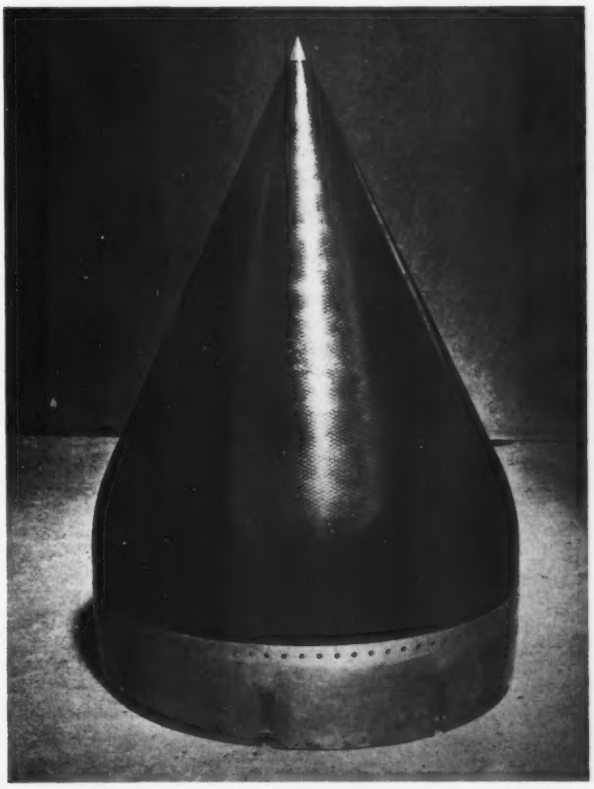
The appeal of the materials is as widespread as any group in the plastic family and ranges from the smallest concerns to the large coachbuilders, the boatyards and to the aircraft companies some of whom have spent many thousands of pounds developing aircraft parts in glass. With the larger companies the attraction lies in the phenomenal strength of the glass fibre itself coupled with the fact that they invariably want parts of complicated shape in comparatively small numbers, more or less regardless of cost. These companies, being able to approach the materials as a research problem, have produced some very interesting parts which have good finish, accurate dimensions and adequate strength characteristics.

In a paper given to the British Plastics Convention in 1955, Mr. J. Rees referred to the difficulty of producing " air bubble " or void free mouldings, a matter of first importance in the manufacture of aircraft components. This difficulty, he said, was the reason why the work was carried out at Bristol on the resin injection method of moulding. Some highly satisfactory results were achieved and the work has since continued to the stage when, by using a multiplicity of moulds, an automatic moulding cycle has been made possible. Although no heavy presses are used a high standard of equipment is needed but the speed of production is still well below that of conventional phenolic or aminoplastic moulding rates. The work is nevertheless valuable and the development most important. There are a number of fields outside aircraft manufacture where reasonable quantities of high strength, accurate mouldings are required which would justify the cost of the necessary equipment and technical control.

Applications in Transport

Several of the bigger transport people have also approached glass fibre plastics with a technical outlook and have considered some of their large curved panel parts as suitable for development in the new materials. The reason for this may be partly technical but, as is indicated later, it has also a strong economic background. The techniques of no pressure moulding have been developed to the stage where complete vehicle fronts have been made and are giving a satisfactory performance in service. Several of the large omnibus companies are now using glass fibre parts as standard but few, if any, have yet put into service a complete bus body in this material.

In the car and caravan body field and to some extent in the boat building industry the approach has not always been very scientific. The progress of the last year or two has been marked



Void-free radome in reinforced plastics for supersonic aircraft, made by Microcell Ltd.

* Consultant.

by the disappearance of the amateur technician and by a better appreciation by those remaining of the possibilities and limitations of hand lay-up methods. The main source of technical trouble has been the tendency to try to make too many mouldings from inadequate moulds. Wood, plaster and some of the more crudely formed resin moulds and aluminium forms are quite satisfactory for prototypes where hand finishing of the moulding after its removal from the mould is permissible. When production is required in batches of 20 or more the cost of the hand finishing and the maintenance of the mould becomes prohibitive and if the activity of a business is measured by the invoicing per square foot of floor space or per person employed the economics become very doubtful indeed for a company of any size. The cost of the ancillary operations has sometimes been overlooked and the customer has often been reluctant to pay the prices quoted for the mouldings in the first place.

The cost of the raw materials of glass reinforced plastics is too high to permit any degree of wastage and it is difficult to avoid a considerable percentage of waste when working with rolls of mat or woven cloth and drums of resin dispensed in buckets. The profit of a hand lay-up glass shop is often to be found, literally, stuck to the floor. It is not surprising that the more enterprising manufacturers are turning towards more adequate moulds and to improved methods of offering the materials to them. For the products of reasonable size such as suitcases and helmets the matched metal mould in steel and with most of the refinements of its counterpart in phenolic moulding are already in common use. In spite of the fact that only a low pressure is needed to mould satisfactorily a hard polished finish is needed which will withstand the hard usage by both material and operator. During the past year a move towards matched metal moulding has been made by producers of larger mouldings and cast aluminium moulds are now being used to produce dinghies and large car panels by the more conventional moulding methods.

Not only does matched metal moulding give a more uniform product, it also permits the use of hot setting resins and reduces the time per moulding from hours to minutes. Preforming instead of tailoring the glass mat does something towards reducing the cost and wastage of the glass fibre but the resin mix is still mostly added to the fibre in the mould as a unit weighing from a bulk mix. The whole process still compares unfavourably with the conventional thermosetting moulding practice of using pre-pelleted powder.

The manufacture of flat or corrugated sheet material by hand lay-up methods is an even more amazing process in this decade. Some of the crudity has gone with the advent of pre-impregnated cloth which is used for the higher strength types but an economic pre-impregnated glass mat is not yet a raw material in adequate supply for the lesser performance type of sheet production. For these reasons, although corrugated roof lighting has made some headway, the use of large surfaces of pressed sheet is slow in developing.

Dough Moulding

Returning to the moulding of shapes, a recent development is the dough moulding compound in which a short glass fibre is used together with substantial quantities of inorganic fillers which partly serve as a sponge for the liquid resins. These are rapid curing, non-wasteful materials and can be used for quite large mouldings. They can be made from virgin glass fibre or from the surplus fibre from other processes, but for consistent results the former, properly mixed in heavy mixing plant, is much to be preferred. The strength of the moulding is lower than would be obtained from a glass mat or a woven cloth reinforcement but is none the less high and impact strengths of 5 ft./lbs. are readily obtainable. Although the outlets for dough moulding compounds are more likely to be industrial rather than domestic they are not unattractive in appearance.

Accurate figures of the size of the glass fibre reinforced plastic industry are impossible to acquire and even the tonnage of glass

L.C.C. Ambulance in polyester-glass materials.

fibre used is no more than a guide since methods of use and diversity of products is so widespread. The bulk of production is undoubtedly that using either roving or chopped strand glass mat and polyester resin. Woven glass cloths in wide variety and some asbestos products are also used whilst epoxy, melamine and phenolic resin bonded goods appear as standard in various manufacturers' catalogues but it is doubtful if they represent more than a small percentage of the industry's turnover.

Future Developments

To assess the future trend is always difficult but there are already evident enough trends to make a forecast not entirely a matter of guesswork.

With regard to reinforcements we have seemed to follow rather slavishly glass as the only fibre to be used regardless of whether its properties were fully needed in the finished product. In a composite product such properties as heat resistance, inflammability, even moisture resistance are unlikely to be substantially better than those of the worst major component. If the trend is for matched metal mouldings to replace wet lay-ups, does it not seem reasonable to suggest the use of the cheaper condensation type resins for many products? Does not the whole picture tend to suggest not so much the revolution in reinforced plastics which has been so highly publicized but rather the additions of a new fibre to our range of reinforcements and one or two new resins to the range of polymers?

What does seem to be new is that we now have the opportunity of combining a non-condensation type of polymer with a very high strength fibre to make a limited range of high strength laminates in small quantities and complicated shapes for highly specialized uses. True the unit value of each moulding or form is high but the use is specialized and the turnover therefore small. Much larger consumption of both new fibre and new resins seem to be possible the closer we approach the more conventional forms of manipulation and it may be anticipated that the largest increase in tonnage in the next phase of this industry is likely to be in matched metal mouldings using dough moulded compounds and pre-impregnated long fibre reinforcements. In the hand lay-up sphere the trends for the future were adequately summed up by one of the leading caravan builders who gave his reasons for continuing to use glass fibre. He said that although glass fibre was much more expensive than aluminium and offered no real advantage in service the cost of the labour for panel beating is so high that for large curved surfaces it becomes economic to use glass fibre. For large flat surfaces, he went on, glass fibre laminates are neither economic nor flat !

The most costly mistake made in the development of resin-glass materials was the assumption that there was only one reason why phenol formaldehyde plastics required steel tools and hydraulic presses, namely water of condensation. Accurate dimensions and good finish in the mouldings were forgotten as also was the cost of the mould per unit of production. Now we have learned these lessons the hard way it is likely that we shall continue to develop adequate machinery to handle the materials and see a very much wider use of the products.

Extruding to Order in Derby

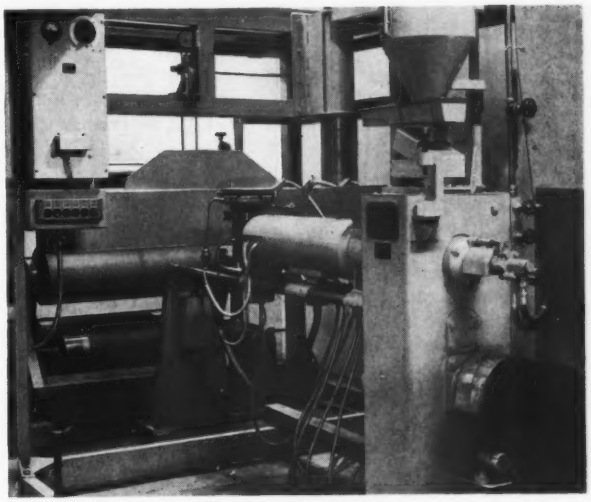
Being a short report of the extrusion department of Albert Green Ltd., New Normanton Mills, Derby.

IN the extrusion section of the plastics industry will be found the names of many well-known companies whose work and products were until recent years, only familiar to other sections of British industry. One of these companies is Albert Green Ltd., whose name has for many years been associated with the manufacture of tapes, ribbons and trimmings. Today they have a thriving extrusion department whose products vary from lay-flat tubing to coated wire and include much trade profile extrusion.

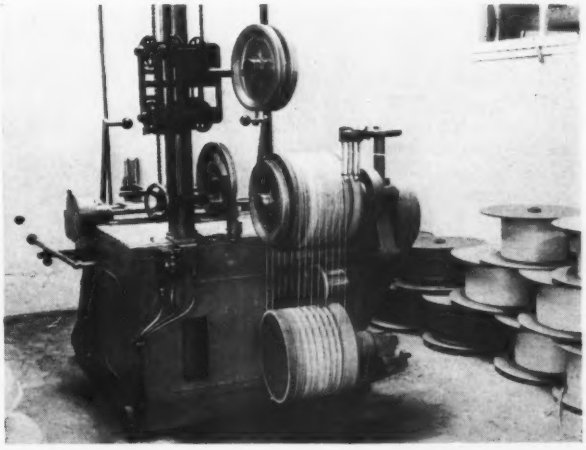
The department is equipped with Reifenhauser and Andouart extruders and working in conjunction with these is the automatic take-off equipment for wire and lay-flat tubing. The extruders are 45 mm. and 60 mm. screw diameter models. Besides extrusion equipment there are complete facilities for printing tube and wire.

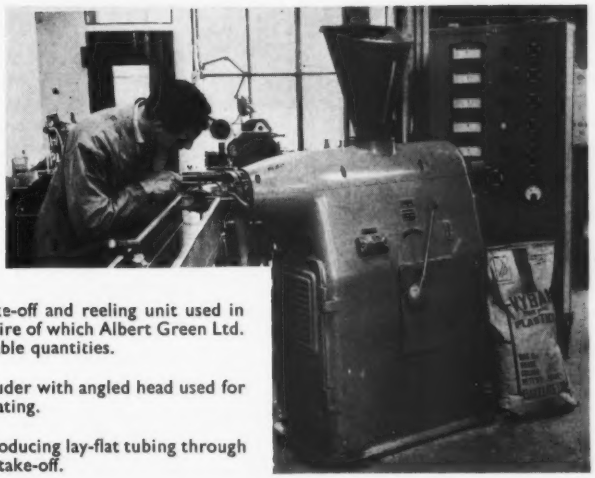
The type of work undertaken by Albert Green Ltd. is, as stated previously, of a varied nature. One of their principal products is lay-flat tubing and on this two extruders are in continuous production using vertical take-off equipment. Widths of up to 12 in. are produced. Besides polythene a considerable quantity of p.v.c. is used both in its plasticized state and also in the more difficult rigid state.

It has not been possible in the short space available to elaborate more fully on the work being carried out by this company but it will be apparent that it is both competent and willing to attempt the varied work that is required to be performed by extruders today. Many of the jobs undertaken are of considerable technical complexity, e.g. the production of thin wall p.v.c. tubing to close tolerances and their successful completion reflects creditably on this old-established company on their recent entry into the plastics industry.



The 60 mm. Burtonwood-Andouart extruder which has been installed for the production of polythene lay-flat tubing.





(Top Right) The Reifenhauser take-off and reeling unit used in the production of plastic-coated wire of which Albert Green Ltd. produce considerable quantities.

(Right) Reifenhauser 45 mm. extruder with angled head used for wire coating.

(Left) The 60 mm. Reifenhauser producing lay-flat tubing through a vertical take-off.

High Polymer Science and Technology in the United States — Part 3

By J. GLAZER,* Ph.D.

Continuing his commentary on the American scene, the author describes in this present instalment his visit to the Du Pont Experimental Station and its various departments. The illustrations are by courtesy of E. I. du Pont de Nemours.

SITUATED just over 100 miles south-west of New York City, and connected to it by the fabulous New Jersey Turnpike Road, lies the town of Wilmington. This was the location chosen by E. I. du Pont de Nemours, a pupil of the famous Lavoisier, for his gunpowder mill in 1802. Just 100 years later, in 1903, a new laboratory called the Du Pont Experimental Station was established within a few hundred yards. At that time the prime function of this laboratory was to develop new materials and to break out into chemical fields other than high explosives. The success with which this was effected is now clear to everyone. Nylon, Neoprene and Hypalon are household words to all high polymer scientists, and the original staff of five (including the director!) has now grown into an overall research staff of more than 2,000 qualified personnel. Of this number, almost half is engaged in research and development at the same Experimental Station, while the remainder are employed at some 40 other research and development centres, scattered all over the United States. The potential of this powerful research organization is backed by an even larger number of technicians and service staff.

In spite of the enormous size of this research organization, the Company does not hesitate to collaborate with university scientists. It appears that about 80 chemists, physicists, biologists and engineers—all of whom hold university appointments—visit the Company's laboratories periodically to discuss problems of mutual interest, and this exchange of ideas is of inestimable benefit to both industry and university. One has only to recall the fundamental researches on polycondensation, carried out by the late W. H. Carothers at Wilmington in the late '20s and early '30s, to appreciate that basic research can be successfully performed in an industrial organization as well as in a university. For this type of work one needs, in addition to first-class scientists and laboratory facilities, an inspiring executive and administrative staff able to encourage and sympathize with its research personnel and conscious of the importance of the discovery of new scientific facts, irrespective of their commercial applicability. Who can now doubt that the enormous growth of the Du Pont Company over the last 30 years has directly resulted from its establishment of a fundamental research programme in 1928 ?

On each of the occasions that I visited Wilmington, I stayed at the Du Pont Hotel and reflected that not many chemical companies in the world can boast their own luxury hotel of several hundred rooms. Here it was disconcerting to find that my first appointment, with a Research Director of the Elastomer Chemicals Department, was for breakfast at 8 a.m. However, he was a charming man, the breakfast was excellent, and by 9 a.m. we had agreed the details of our programme for the day, and started on our business.

Organization of Research

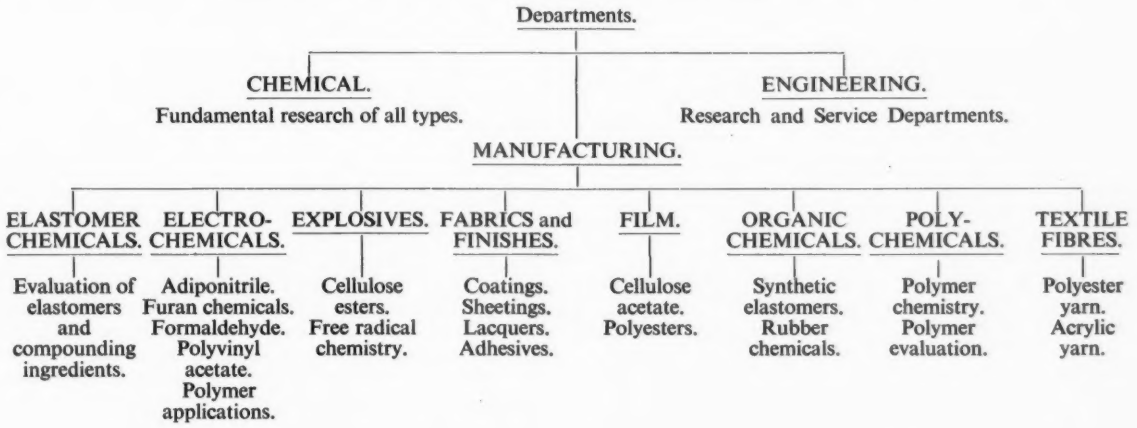
The Experimental Station is primarily a centre of research. As far as possible, development work is carried out on local sites throughout the country—usually in the locality of the manufacturing plant. This is not to say that *applied* research is not done at the Station, for indeed it is. The conception of research is best summarized by regarding it as critical investigations into the natural sciences whereby new scientific knowledge is acquired. Consequently, the Company divides its research interests into three main groups. These are (*a*) fundamental research, (*b*) research on new processes and materials, and (*c*) research on existing processes and materials. In general these three divisions exist in each of the research laboratories associated with the many manufacturing departments of the Company. The advantages of this arrangement are clear, but the most important one—to my mind—is that fundamental and applied research is going on in the same building at the same time. The applied scientist has no difficulty in locating a pure scientist and they are able to discuss their problems and results freely, in the same laboratory. This interchange is often formalized by holding research colloquia where members of the laboratory lecture on their particular topics to their colleagues.

As a result of this type of grouping, the Experimental Station is divided into a number of separate laboratories, most of which come within the province of the dozen or so manufacturing departments of the Company. There are two important exceptions to this arrangement, and these are the Chemical and Engineering departments. The Chemical department is not restricted to any one manufacturing department. Instead, it has a roving commission in research that is both fundamental and long range. In spite of its title, this department additionally carries out investigations in physics, botany and zoology all of which may be pure or applied. On the chemical side, studies include organic synthesis, high polymer physico-chemical studies and polymerization kinetics. The pioneering work on polycondensation mechanisms was, in fact, carried out in this department. The Engineering department has its own research laboratory and its prime function is to investigate new fields in design, construction and operation irrespective of whether these

Molecular structures of high polymers are studied with this nuclear magnetic resonance apparatus.

* Senior Lecturer in Polymer Chemistry, National College of Rubber Technology.

RESEARCH ORGANIZATION AT THE EXPERIMENTAL STATION



problems arise out of manufacturing plants or research laboratories. The services of the Engineering Research Laboratory are therefore available to all of the neighbouring research laboratories on the Experimental Station. These neighbouring laboratories are those of the manufacturing departments, and I have tried to summarize the interests of these departments in the chart above. I have omitted mention of six manufacturing departments since their work does not appreciably involve high polymers.

Elastomer Chemicals Department

The youngest is the Elastomer Chemical Department which was, until recently, a part of the Organic Chemicals Department. However, the growing importance of elastomers has resulted in its emergence as a full department in its own right. It is typical of the growth of the Company, that when this department was born there was no room left for its research laboratory on the Station site. As a result, it is located at Chestnut Run, just a few miles away. The primary function of the Elastomer Chemicals Laboratory is to evaluate new chemical ingredients for rubber technology as well as to pioneer studies into potential elastomers. These new laboratories are very well equipped with processing and testing apparatus and with trained scientists and technologists. I was particularly impressed by the versatility of the laboratory structures. These were assembled on the " unit " principle and both the arrangement and the size of the individual laboratories can be easily changed as developments require.

Polychemicals Department

The research laboratory of the Polychemicals Department, a fine new building in the Station, houses a variety of research teams working on a wide range of problems of interest to pure and applied polymer scientists. During October last, the Du Pont Company announced its new thermoplast " Delrin " with the news that a manufacturing plant was being built in Virginia. This plant is expected to be in production by the summer of 1959 at which time, no doubt, the product will be available to Great Britain. I was fortunate in being able to see and handle this new material and am convinced that it will find a ready market here when it arrives. It is a tough, rigid material of high tensile strength and heat distortion temperature and it can be moulded or extruded by normal techniques. The material was synthesized and developed in the research laboratories of the Polychemicals Department, and fundamental studies are still being actively pursued there in the hope of understanding the physical structure and improving the properties of this new product. Chemically speaking, the material is polymethylene oxide, the monomer being formaldehyde. The latter has been known to be capable of polymerization for many years, but no one had been able to induce it to form stable, linear polymers of high molecular weight. This has now been achieved and the resultant product, which physically resembles nylon, is highly crystalline. Its high crystallinity is undoubtedly due to its regular residual form and its low residual volume. Unfortunately, " Delrin " is not yet available for research or development assessment in Europe owing to the extremely limited supply position.

" Delrin " is, however, only one of the polymers of current interest to Polychemicals' research staff. Polyethylene, polymethyl methacrylate, polytetrafluorethylene, nylon and cellulose esters are but a few of the well established polymers that are still being improved upon and developed by research. Physicists, chemists and engineers mingle together and co-operate under one roof in their search for new scientific facts. I was particularly interested to meet an old colleague (a surface chemist from Cambridge) who was investigating certain fundamental aspects of adhesion. Polytetrafluorethylene and its copolymers are of great interest to surface chemists by virtue of their characteristic friction and lubrication properties. These same properties give rise to bonding and adhesion problems that cannot

Fundamental studies in the Polychemicals Department relate physical properties of polymers to chemical structure.

be solved by classical means. Indeed, these polymers can only be rendered satisfactorily " sticky " by oxidizing or chemically altering the surface. It was pleasing to hear of fundamental work being performed with these polymers which is resulting in a greater understanding of their surface properties. Polyethylene is another material that possesses a comparatively inert surface, and the research staff of this department has done some very fine work in elucidating the nature of the so-called " flame treatment " which is given to polyethylene to improve its heat-sealability and printability.

Organic Chemicals Department

The Organic Chemicals Department maintains a flourishing laboratory in the Experimental Station whose main purpose is long term research in organic and physical organic chemistry. It is sub-divided into a polymer-organic division and an organic division. The former is concerned with researches into the production of elastomer monomers, auxiliary chemicals for elastomer production and processing, and fundamental studies of emulsion polymerization and vulcanization. The latter is more concerned with petrol additives, lubricants, detergents, refrigerants and pharmaceutical intermediates—none of which are of prime interest to polymer scientists.

The Jackson Laboratory is part of the Organic Chemicals Department research organization. Although it is located just across the Delaware River from Wilmington, it is sufficiently near the Experimental Station to be considered a component part. In the elastomer field, this laboratory occupies an honoured position since it was here that neoprene was invented in 1931, and it is extremely fitting that, some 25 years later, the same laboratory should publish the first satisfying theory for the mechanism of vulcanization of this elastomer. As a result of this theory, it has been possible to design latices of improved ageing properties.

Although the Jackson Laboratory is almost 40 years of age, its equipment is quite modern and it contains almost every piece of apparatus that the scientific heart could desire: a chemical store of more than 60,000 chemicals, fractionating and molecular distillation units, ultra-violet, visible and infra-red spectrometers, a nuclear magnetic spectrometer, a mass-spectrometer, X-ray crystallographic equipment and an electron microscope incorporating electron diffraction ancillaries. These facilities are backed by an analysis department and almost 200 trained laboratory technicians, glass-blowers and engineers. The laboratory library currently receives over 500 technical periodicals, although the main library of the Experimental Station (The Lavoisier Library) itself receives, independently, some 800 technical periodicals. Both of these libraries are well stocked with books and up-to-date collections of patent literature pertaining to the chemical industry.

Electrochemicals Department

The Electrochemicals Department is perhaps the most versatile of the manufacturing departments, as can be gauged from typical products such as adiponitrile (a nylon intermediate), hydrogen cyanide and acetylene (neoprene intermediates), formaldehyde (" Delrin "), furan derivatives, polyvinyl acetate and alcohol, and peroxides. In its laboratory many aspects of polymerization chemistry are being investigated.

The Jackson Laboratory of Organic Chemicals Department.

High pressure facilities are available for polyethylene synthesis and at the same time novel methods are under study for the synthesis of the department's products.

Textile Fibres Department

Of the seven research laboratories of the Textile Fibres Department, two are situated in the Experimental Station and they are both concerned with the invention and development of textile fibres made from synthetic high polymers. The first of these is the Pioneering Research Laboratory which concentrates as far as possible on fundamental research, leaving process and development research to its sister laboratories in Virginia and North Carolina. Once again chemists, physicists and engineers combine their efforts to produce and investigate new polymers, polymer intermediates and polymer solvents and plasticizers. Organic chemists synthesize new fibre-forming polymers, while physical chemists investigate their structure using all possible modern laboratory techniques. And finally, the research engineers study any novel chemical and mechanical engineering problems that may arise out of the production methods associated with the new fibres.

The second of the Textile Fibre laboratories is the Carothers Research Laboratory. This laboratory is concerned with melt-spinnable polymers and is named, very appropriately, after the inventor of nylon. Super polyamides are here prepared from new types of intermediates and the spun yarn is evaluated. In the course of these studies, the full impact of physical chemistry is brought to bear on the problems involved. X-ray diffraction and infra-red methods are used to investigate the amorphous and crystalline phases of the polymers and rheologists analyze the spinning and fibre-drawing processes that go to make the product a commercial success.

General Impressions

In summarizing my impressions of this immense Experimental Station, it must be said that—in spite of the overwhelming size of the establishment—human relations are excellent. I could find no trace of anything approaching a " robot " community, and in the course of my discussions with the research staff I learnt that a " bench " scientist may choose to remain at his experimental work and still advance in the Company both in responsibility and in salary. The fear of many research scientists that they will eventually be forced to take an administrative post, if they are to make progress in an organization, is certainly not operative in this case. Less this be construed in the wrong way, let me hasten to say that the President and all but one of the Vice-Presidents of the Du Pont Company began their careers as chemists or engineers !

(*To be continued*)

The Physical Properties of Polymers

Summaries of the papers presented at the Silver Jubilee Symposium of the Plastics and Polymer Group of the Society of Chemical Industry.

THE Plastics and Polymer Group of the Society of Chemical Industry held its Silver Jubilee Symposium last month at Senate House, London University. For this occasion, a general theme was chosen, "The Physical Properties of Polymers," as distinct from the specialized symposium usually held by the Group. The range of materials was wide, there being 19 papers.

The following summaries indicate the broad lines of the work covered. The papers will be published in full in due course by the S.C.I., 12 Belgrave Square, London, S.W.1.

"*Crystallinity in Polymers: Occurrence, Measurement, and Influence on Properties.*"

By C. W. Bunn, Imperial Chemical Industries Ltd., Plastics Division.

Most polymers with geometrically regular molecules crystallize, while most of the undoubtedly irregular ones do not; the few exceptions to this generalization can be explained reasonably. The highest proportions of crystalline material, around 90%, are found in polymers with the shortest chemical repeating units, like polymethylene and polytetrafluoroethylene. The influences of chemical constitution and thermal history are discussed.

The principal methods of estimating the proportion of crystalline material, based on X-ray diffraction, density, and infra-red absorption, are critically reviewed. The recently proposed nuclear magnetic resonance method gives the proportions of relatively stationary and mobile material, which do not necessarily correspond to the proportions of crystalline and amorphous material.

In any one polymer, certain mechanical properties depend primarily on the proportion of crystalline material. In polythenes, both Young's modulus and the yield stress increase steeply with increasing crystallinity; for yield stress the relation is linear over the range 52% to 83% crystallinity.

"*Optical Properties of Strained Amorphous Polymers.*"

By D. W. Saunders, British Rayon Research Association.

In the stress-free state transparent rubber-like polymers are found to be optically isotropic. On being deformed by the application of stresses this isotropy generally disappears, the polymer becoming birefringent. The detailed dependence of birefringence on the applied stress and resulting deformation is predicted, for an ideal network, by an extension of the kinetic theory of rubber-like elasticity. The paper sets out to compare the observed behaviour of semi-rubber-like systems with the predictions of the theory, under two main sections—the dependence of stress-optical properties on (1) type of strain, and (2) degree of cross-linking.

"*Structure and Properties of Polypropylene.*"

By P. W. O. Wijga, Koninklijke/Shell-Laboratorium, Amsterdam. N.V. De Bataafsche Petroleum Maatschappij.

The various factors which determine the mechanical properties of polypropylene are discussed.

Crystallinity and crystalline structure are shown to be important for yield stress, modulus of elasticity and in combination with other variables for brittleness.

Average molecular weight and molecular weight distribution are important for the viscosity behaviour and brittleness.

The relations between molecular weight, molecular weight distributions and crystallinity, required for polymers with optimum mechanical properties, are demonstrated.

"*Permeability of Plastics and Rubbers to Water and Water Vapour, as Measured by the Hygrophotographic Method.*"

By J. Sivadjian, Institut Pasteur, Paris.

A hygrophotographic process is described, which permits the determination of minute quantities of water and water vapour diffusing through plastics, rubbers, leather and similar materials. Special mercury and silver iodide plates are used which are very sensitive to water and humidity. The negatives obtained are fixed by direct printing (contact method), using standard photographic plates or papers.

"*Mechanical Properties of Sheet Forming Thermoplastics at Fabrication Temperatures.*"

By L. W. Turner, Dr. V. E. Yarsley (Research Laboratories) Ltd.

An examination is made of the methods of evaluating thermoplastic sheet materials in terms of their current applications in the vacuum forming field. A method is described which has been developed specifically for this purpose and its use with four materials analysed. The materials examined are styrene-acrylonitrile-butadiene, toughened polystyrene, a p.v.c. copolymer, and rigid p.v.c. Results obtained are reviewed under the headings effect of stress, time, temperature and material.

"*The Effect of Injection Moulding Conditions and Flow Orientation on Properties.*"

By D. J. A. Lee, R. A. Horsley, and P. B. Wright, B.X. Plastics Ltd.

The effect of different moulding conditions on the mechanical properties of a general-purpose and toughened polystyrene has been studied. Flow-orientation has a marked effect on certain properties, notably the impact strength of thin mouldings. The amount of orientation is controlled mainly by the moulding temperature and can be measured by shrinkage and relative retardation tests.

"*The Measurement of the Mechanical Properties of Plastics at Very Low Temperatures.*"

By G. C. Ives and J. A. Mead, Yarsley Testing Laboratories Ltd.

The growing interest in the storage of liquefied gases, in particular liquid oxygen and methane, has focused attention on the lack of data relating to the behaviour of thermal insulators, flexible hosing and materials of construction at the low temperatures involved. A simple apparatus is described for measuring the mechanical properties of small specimens of such materials down to approximately —195° C.

"*Breakdown of Polymeric Insulation by Gaseous Discharges.*"

By N. Parkman, Electrical Research Association.

The author describes apparatus developed for the work, and makes a review of the physical processes involved in gaseous breakdown. He then reviews the effects of discharges as organic dielectrics, effects of ambient conditions, and surface arc and track resistance.

"*Electrical Tracking Testing.*"

By G. C. Ives and M. M. Riley, Yarsley Testing Laboratories Ltd.

The phenomenon of tracking is defined and described briefly and an outline given of the various test methods which have been proposed for the evaluation of resistance to tracking. A method proposed for international adoption has been examined in detail and found not to be wholly acceptable in its present form.

"*Conduction and Polarization Processes in Plasticized Polyvinyl Chloride Compounds.*"

By W. Reddish, Imperial Chemical Industries Ltd., Plastics Division.

Results are presented of parallel measurements of the current-time response to applied uni-directional step voltages and of the A.C. power factor and dielectric constant behaviour for two compounds of polyvinyl chloride with di-2-ethylhexyl phthalate plasticizer.

The D.C. and A.C. data have been reduced, by means of an approximation due to Hamon, to a unified presentation to the

integral derived from superposition theory. The locus of the principal relaxation process, which is familiar as a loss/dispersion process in the A.C. data, is shown to extend continuously into the very-low-frequency region formally associated with the time scale of the D.C.-step response data. The self-consistency of this presentation is thought to provide further vindication of Hamon's approach.

By means of this analysis, the contributions of steady-state conduction and of polarization processes to both A.C. and D.C. behaviour are effectively separated. Such a separation is of value as an essential preliminary to studies of the chemical basis of conduction and polarization, and also in connection with the use of p.v.c. compounds as insulation. In this latter context it is shown that the conventional volume resistivity parameter when measured at room temperature is of little value as an index of the quality of present-day compounds, because it may contain a dominant polarization component.

" *Impact Strength of Tough Plastics.*"

By H. G. Hulse, Monsanto Chemicals Ltd.

After defining the group of materials coming under the heading of " tough " plastics, the author reviews impact strength tests available. He then relates impact strength to impact service resistance. The paper is amply illustrated with graphs and tables.

" *Variation of Physical Properties of Melamine Moulding Materials with Curing Time.*"

By D. E. Morgan and C. P. Vale, British Industrial Plastics Ltd.

First, the methods of test for cure are reviewed. This is followed by a discussion of the work carried out by the authors in the examination of three commercial grades of melamine powders. The results are considered under the headings cross-breaking strength, tensile strength, impact strength, boiling and cold-water absorptions, electrical breakdown strength, volume resistivity, surface resistivity, power factor, permittivity, mould shrinkage and after shrinkage.

" *Applications of Rebound Resilience to the Cure of Polyester Resins.*"

By R. H. Barrett and M. Gordon, Arthur D. Little Research Institute and College of Science and Technology, Manchester.

The curing reactions of resins containing polyfumarate condensation chains have been investigated on two important systems: (1) polyethylene fumarate in admixture with methyl methacrylate, and (2) polypropylene fumarate in admixture with styrene.

Chemical cure can become arrested in a pseudo-equilibrium state, when the glass transition rises to the polymerization temperature. Radiation cure, unlike chemical cure, can be induced, however, far below the glass transition of a polymer. A true equilibrium cure can be attained in both systems by chemical means in the rubbery state of the polymer (i.e., at sufficiently high temperature). In system (2) such equilibrium cure exhausts the unsaturation present, and further cure cannot then be induced by irradiation. In system (1), however, much of the unsaturation can survive at the chemical equilibrium cure, and further cure can then be effected by irradiation. A high initial fumarate content is favourable for such after-cure by radiation, both because more fumarate unsaturation survives at equilibrium and because the degradation of the methacrylate component is then minimized.

" *Some Applications of Dynamic Elastic Measurements in Polymer Systems.*"

By E. B. Atkinson and R. F. Eagling, B.X. Plastics Ltd.

Information about changes of structure and molecular mobility in high polymers with change of temperature can be obtained by measurement of the dynamic elastic modulus and the mechanical loss factor of the polymer. Results obtained with a simple apparatus are given to illustrate the application of this method to pure polymers, polymer mixtures, plasticized polymers and graft copolymers.

" *Non-Linear Viscoelastic Effects in Ethylene Polymers.*"

By D. J. H. Sandiford, Imperial Chemical Industries Ltd., Plastics Division.

Stress relaxation moduli, $E_r(t)$, and tensile moduli, $E_s(t)$, at five different strain rates $\dot{\varepsilon}$, have been measured: five ethylene polymers ($p = 0.919/0.968$) and strains, ε, up to 0.02 have been used. Dynamic modulus $E'(\omega)$ and loss factor $\tan\delta$ have also been measured at two frequencies between 20 c/s. and 1,700 c/s. It has been found that departures from viscoelastic linearity occur for $\varepsilon = 0.001$. The unique $E_r(t)$ and $E_s(t)$ curves of linear theory coincide, but the experimental curves of log(modulus) *vs.* log(time) break up into two intersecting families of approximately parallel curves. The correlations of these results with $E'(\omega)$ are discussed and some suggestions about the mechanism of deformation, involving reversible breakdown of the crystallite structure, are given.

" *The Relation Between Coefficient of Friction and Dynamic Properties of Polyvinyl Chloride.*"

By D. I. James, R. H. Norman and A. R. Payne, Research Association of British Rubber Manufacturers.

This paper describes the relationship which has been found to exist between the compliance and the coefficient of friction of mixings of polyvinyl chloride (p.v.c.) with various quantities of di-(2-ethylhexyl) phthalate (DOP). From the study of a crude model, a relationship was anticipated on theoretical grounds. The experimental relationships do not fulfil quantitatively the theoretical expectations, but the predicted steady increase of coefficient of friction with increasing compliance is found to occur experimentally. The paper indicates further lines of approach to the subject which may show the reasons for deviations from the steady increase at high values of the compliance.

" *Dynamic Mechanical Behaviour of Partially Crystalline Polymers.*"

By A. E. Woodward and J. A. Sauer, Pennsylvania State University.

The authors report fundamental work on the measurement of internal friction and dynamic elastic modulus on a number of partially crystalline polymers.

" *The Influence of Strain Upon the Dynamic Properties of Natural Rubber.*"

By P. Mason, British Rubber Producers' Research Association.

The dynamic properties of natural rubber in simple extension have been measured using a wave propagation technique. From measurements of the temperature-dependence of the loss factor it appears that the glass transition temperature is not greatly influenced by extension. Reduction of the data has therefore been carried out by Ferry's method of reduced variables using a single reference temperature (— 20°) for all extensions. For extensions up to 600% the dynamic modulus increases by as much as two orders of magnitude, the factor depending on the particular temperature and frequency considered; the dependence on extension at a single (high) temperature is in substantial agreement with values of the differential modulus derived from a conventional " static " stress-strain curve. The loss factor also varies considerably with extension, going through a maximum in the vicinity of 100% extension and decreasing continuously at higher extensions.

" *The Mechanical and Dielectric Temperature/Frequency Equivalence of Polymers : GR-S.*"

By A. R. Payne, Research Association of British Rubber Manufacturers.

The method of reduced variables has been applied to the dielectric and dynamic mechanical measurements of unvulcanized and vulcanized samples of synthetic rubber, GR-S, as well as to the dynamic mechanical properties of carbon-black-loaded GR-s vulcanizates. The overall master curves of property against frequency have been obtained, and the characteristic reference temperatures (T_s) determined from the experimental results by the use of a recently-published empirical equation describing the temperature/frequency equivalence of polymers. A comparison of the dynamic mechanical and dielectric behaviour of the synthetic rubber GR-S with that of natural rubber is given.

World's Industry Employs Plastics

The original articles from which these abstracts are taken can be seen at the Patent Office Library, 25 Southampton Buildings, Chancery Lane, London, W.C.2. Photostat copies can be obtained from the same source, price 1/6 per page (postage extra). It should be noted that the page number given below the abstract is that of the page on which the article commences.

MATERIALS

Plastics in Europe

AN economic survey by Wittmeyer and Theurer dealing with production, import and export statistics for West Germany, France, Italy, Belgium-Luxembourg, Holland, Great Britain and the United States of America for the years 1954, 1955 and 1956. Data are presented mostly in tabular form and include, amongst others, figures for total internal consumption of the synthetic resins and internal consumption of the various types of plastic. Tables 6 and 7 are particularly interesting as they present for the countries named, *per capita* comparative figures for consumption of plastics, steel, coal and petroleum products (expressed in terms of crude oil), the first in terms of weight per head, the second in terms of volume per head. It is to be regretted that no corresponding figure is given for aluminium. According to Table 6, the ratio of the *per capita* consumption by weight of steel to plastics in U.S.A. is approximately 60 : 1. By volume it is somewhat less than 10 : 1.

(*Chemische Industrie*, 1958/Feb./45.)

Polyvinyl acetals

A TECHNICAL account of the chemical, physical and mechanical properties of the polyvinyl acetals by Lucchetti. The author commences with a brief summary of the chemistry of the preparation of these compounds and presents next two tables, the first summarizing the thermal and physical characteristics of the acetals obtained by reacting polyvinyl alcohol with aldehydes including the following: —acetaldehyde, propionaldehyde, isobutylaldehyde, normal butylaldehyde. The second table gives solubility of these acetals in methyl and ethyl alcohols, in acetone, dioxane and other solvents. The effect of heat upon the compounds is examined and the author concludes with a table giving the thermal and physical characteristics and the related mechanical properties of the acetals plasticized with a variety of common plasticizing media.

(*Materie Plastiche*, 1958/Jan./33.)

High Molecular Weight Polymers of Ethylene Oxide

THREE articles written by members of the research team who developed Polyox for Union Carbide give details of its polymerization, solution properties, and plastics properties. In polymerization viscosities up to about 10 can be made using an alkaline earth carbonate as catalyst. Certain conditions are given. The solution properties quoted show that these polymers are miscible with water in all proportions and are soluble in certain organic solvents. Viscosities of even highly diluted aqueous solutions are shear-dependent and display considerable polymer interaction. The plastic properties of Polyox include a tensile strength of from 1,800 to 2,400 p.s.i. elongation of 700% to 1,200%, and tensile modulus, stiffness of 30,000 to 70,000 p.s.i. The melting point is 66° C. A further characteristic of the materials is their very high degree of crystallinity under most conditions.

(*Ind. & Eng. Chem.*, 1958/Jan./5.)

Polypropylene

AN account by Krentsel of the physics, chemistry and mechanical properties of the polypropylenes. The method of manufacture is described together with some indication of their use. A brief summary is made of their heat-resisting qualities as compared with those of polyethylene and polystyrene. Illustrations and tables are included in the account.

(*Piroda*, 1957/Oct./81.)

New Process for Glass Fibre

A BRIEF account is given of the Saint-Gobain process for manufacturing glass fibre which, it is stated, will soon be operated not only in France but also in Denmark, Sweden, South Africa, Australia, Great Britain and U.S.A. A description is given of the basic operation of the process which consists first in producing a relatively coarse fibre by centrifugal process and afterwards subjecting this to a refusion of short duration, thereby obtaining a secondary fibre of diameter less than 1 micron. The Saint-Gobain factory at Rantigny has recently been equipped with new plant throughout. It is stressed that the composition of the glass used in the process must be maintained within very close limits.

(*France-Industries*, 1957/Oct./25.)

TECHNOLOGY

X-ray Absorption in Plastics

A PAPER by Nordfors on the X-ray absorption in polystyrene and formvar in the region 1-9 kXV continues earlier work in which the X-ray absorption coefficients for cellulose acetate, regenerated cellulose, nylon, Mylar and Teflon were experimentally determined (A. E. Sandstrom and B. Nordfors, *Ark f. Fysik*, 1954, page 147.) All these materials can be obtained as thin foils and used as counting tube windows and as substrates for absorbers, thus it is desirable that their transparency to X-rays be known. Graphs are given for linear absorption coefficients of polystyrene and formvar and for the transparency of these materials in relationship to thickness.

(*Arkiv för Fysik*, 1957/Vol. II/No. 6/587.)

Chemical Interactions in the Poly(vinyl formal)-Phenolic Resin System

RESEARCH on cured poly(vinyl formal)-phenolic magnet-wire enamel requires a greater knowledge of its actual structure. This in turn requires a better understanding of the fundamental chemical reactions that take place in that resin system.

The investigation described in an initial study of the effects of intermediate temperatures, acid catalysts, and antioxidants on some simple monomers and polymers related to the original resin components.

The results clarify under specified limited conditions, various chemical interactions among the known functional groups in this resin system.

(*Ind. Eng. Chem.*, 1958/Feb./229.)

Dilation Characteristics and Structure in Isomeric Polymers of Ethylene and Alpha Olefines

THE specific volumes of various polyethylenes and of amorphous or crystalline stereoisomeric polymers, of propylene and butylene have been determined as a function of temperature by Danusso, Morgolio and Natta who presented the results of their research to a convention on plastics at the Conservatoire National des Arts et Metiers, Paris, July, 1957. Data are presented in the form of a series of graphs. From their work the authors draw certain conclusions as to the structure of the polymers referred to and as regards specific structural changes in relationship to temperature.

(*Industrie des Plastiques Moderne*, 1958/Jan./40.)

Identifying Non-Flam Film

IN order to distinguish non-flam or partially non-flammable film from the inflammable type, it is noted that incorporation in the non-flam film mix of a fluorescent dye provides a suitable mechanism, the film being merely exposed to U.V. light and its behaviour noted. Suitable fluorescent compounds are listed together with relative patent numbers. A good bibliography is included.

(*Photographische Korrespondenz*, 1958/Feb./19.)

MACHINERY

Infra-red Radiation in the Working of Plastics

A PAPER presented by Geslin before the Commission Mixte des Emetteurs Infra—Rouges et des Textiles du Comité d'Electrothermie, Paris, June, 1957. The author summarizes first the advantages of infra-red heating and then discusses various types of emitter, especially from the standpoint of their radiation characteristics. He then passes on to a consideration of the use of infra-red heating for effecting polymerization of synthetic

resins in impregnated textiles and on the surface of papers. Reference is made to vinyl polymers and to silicones. Tabular data give working details and indicate, *inter alia*, power consumption and speed of polymerization. Production of nylon fibres assisted by infra-red heating is dealt with in conclusion.

(*Industrie des Plastiques Moderne*, 1958/Jan./35.)

New Plant and Equipment for the Drying and Pre-heating of Thermoplastics Prior to Working

A SPECIAL funnel by W. F. Hoffmann and Co., Copenhagen—K, FRH.—Kanal 6, is described. Known as the "Continator" it consists of a funnel with a loose inner funnel into which the material to be treated is sieved. Hot air is admitted through a valve through the charge and exhausted via the double walls. The air, which is filtered before admission, is electrically heated, control of the heater being by means of a "Sunvic" thermostat. The volume of air used can also be controlled. The apparatus is constructed of aluminium in order to avoid corrosion problems and is readily cleaned. A bottom filter enables very fine grain materials to be handled. The "Continator" occupies very little space and may readily be fitted to any injection moulding or extruding machine. In order to ensure that the charge be adequately dried, a continator of ample size should always be used. Further to promote the efficiency of the machine, a special air drier can be incorporated. The use of this machine ensures that the plastic is fed to the injection moulder or extruder already pre-heated, thus saving thermal energy, whilst the hot air which is drawn off may be re-circulated to affect still further economies. A magnetic separator may be fitted to remove iron particles from the charge.

A weighing device by Engelhardt GmbH, Fürth in Bayern, Flössaustrasse 183, is described, by means of which accurate charges may be metered to injection moulding machines.

A screw type extrusion press of the S.P. series by Friesecke and Hoepfner GmbH, Erlangen, Bruck, is described, with a hydraulic pressure measuring and correcting attachment. This is illustrated.

For welding operations on hard and soft p.v.c., polyethylene, polyamide, polyisobutylene, and polymethyl methacrylate, a convenient electrically-heated hot-air torch has been developed. It is provided with an integral blower and can be plugged in to any lighting point. The temperature of the air 5mm. from the jets may be regulated in the first stage to 180–220 to 260° C., and in the second stage from 350–400 to 500° C. It is emphasized that the blower motor is amply dimensioned to guard against any over-loading. The apparatus operates from a 220 volt supply, D.C. or A.C. The first stage heating takes 250 watts, the second stage 400 watts. It weighs 1,100 gm., and will weld hard p.v.c. at 300 mm. per minute and soft p.v.c. at 1,000 mm. per minute. Models are also available for running off 110 volt and 42 volt supplies.

Laboratory table type screw feed extrusion press HW20, manufactured by Heinrich Wenigmann in Haan (Rhld), is suitable for working all types of thermoplastics such as hard and soft p.v.c., low pressure and high pressure polyethylene, cellulose acetate, Novodur and the polyamides. The machine is provided with complete thermal and mechanical controls and may be employed not only for laboratory research purposes but also for investigations into the use of colouring matter and for examining the characteristics of different types of materials. It will undertake the widest variety of work. The screw feed is of special steel, hard chromed; its diameter is 20 mm., and its length 300 mm. Speed of rotation may be varied continuously from 10 to 70 r.p.m. Operation is by means of a 1 h.p. motor.

(*Der Plastverarbeiter*, 1958/Jan./21.)

APPLICATIONS

Finish-machining Teleprinter Parts

A DETAILED account by Grohmann of problems involved in various precision finishing operations on teleprinter components which are often of complicated form and demand close tolerances, thus giving rise to special difficulties in jigging and chucking for drilling or turning. A special holding device for a cast aluminium part is described in which the rigidity of the part in the drilling jib is ensured by the provision of a soft Mypolam (p.v.c. 5319; Dynamit, Troisdorf) bed. This is used in conjunction with a specially channelled jig plate and deforms reversibly to the shape of the part when the latter is held down by two claw fixtures which exert upon the part to be machined a load which gives no distortion.

(*Feinwerk Technik*, 1957/Oct./347.)

Decorative Laminates

SOME attractive illustrations in half-tone and colour are presented of door panels in polyester resin reinforced with glass-fibre textile of the "Vetrotex RMP" brand (Vetreria Italiana Balzaretti Modigliana, Via Borgona, 1, Milan). These laminates are manufactured by the Plastoglas Italian dei Fratelli Bonaiti, via Armellini 29, Milan. High strength, lightness and dimensional stability are claimed. The doors illustrated consist of one single framed panel. They are obtainable in various colours and are recommended for use both in public and private buildings.

(*Poliplasti*, 1957/Dec.-Nov./Advertising pages LXII, LXIII, LXIV.)

Construction of Bubble Chamber

IN a small bubble chamber constructed by E. D. Alyea, Gallagher, Mullens and team for testing high-density corrosive liquids (e.g. WF_6), quartz windows are fitted and these for temperatures below 200° C., and are made gas-tight with Teflon gaskets.

Teflon is also used for numerous other seals.

The expansion diaphragm "O ring" combination is machined from a single piece of Teflon, the flat part being 0.76 mm. thick and 3.8 cm. diameter. This diaphragm is backed by a Hycar rubber disc and a piece of perforated polyethylene. Tests with Teflon showed that it is essentially unaffected by WF_6, although at the end of the run, the Teflon window gaskets had changed from white to light-grey in colour; they had flowed badly (under pressure?) but were still flexible. Teflon gaskets at room temperatures were unaffected but all Teflon surfaces exposed to (heated?) WF_6 grew thin "whiskers" up to 3 mm. long. Hycar was found to be attacked but not penetrated by the WF_6. It is implied that WF_6 may diffuse through Teflon.

(*Il Nuovo Cimento*, 1957/Dec. 14/80.)

Industrial Flooring

A COMPREHENSIVE survey by M. Méchin of the requirements for the working surfaces of industrial flooring and of the various non-metallic and metallic materials used for the purpose. The construction of various flooring systems is described with diagrams, and their advantages and disadvantages considered with reference to a variety of operating conditions. Plastic floor coverings are noted, especially those based on p.v.c. It is observed that though these have good wear resistance, they scratch readily and will tend to break down under repeated impact loading; furthermore, their heat storage qualities are poor. Reference is made, however, to their excellent elastic properties underfoot and to their resistance to acid and alkaline chemicals. They are recommended for laboratories, offices, canteens, surgeries and shops. Plastic coverings should be laid on a rigid surface and one that is perfectly flat. Joining is effected by welding or by means of synthetic adhesives. The use of an adhesive film between the base and the plastic covering is suggested.

(*Ingénieurs et Techniciens*, 1957/Nov./75.)

Waterproofing a Tunnel

A BRIEF note by Chiostri of the Montecatini organization on the waterproofing of a subway, the serviceability of which was imperilled by the infiltration of water from the surrounding soil. The walls of the tunnel were of cement and immediately in contact with this at the upper surface and on each side was placed a polythene film 0.1 mm. thick, these serving to render the structure entirely proof against ingress of saline waters.

(*Materie Plastiche*, 1958/Jan./24.)

Plastics in the Sewing Machine

PARDUCCI presents the results of a detailed examination of the Merilla portable sewing machine for electric or hand operation by Necchi. The account is very completely illustrated, the subject matter of each illustration being the different parts of the machine, then being so grouped as to illustrate the application of specific types of plastic. The first shows accessories in Vinilpelle (p.v.c.). Parts of the electrical and lubricating system are in polystyrene and polyethylene respectively. A variety of small parts including adjusting handles are in cellulose butyrate, whilst other components including those for the thread tensioning and tension adjustment are in nylon. The motor support complete with radio and T.V. suppressor is in reinforced phenolic, some plugs and other attachments being likewise in phenolic resin. In the same review, the author also examines a variety of products of outstanding design such as basins, domestic electrical appliances and lighting fittings in polyethylene, polyamide, reinforced polyester, transparent polymethyl methacrylate and polyvinyl chloride.

(*Materie Plastiche*, 1958/Jan./25.)

New Productions

Polythene/Rubber Hose

A new polyethylene-lined rubber hose for the conveyance of concentrated mineral acids has been developed by Dunlop under the trade name of Valithene.

The hose, which represents an important advance over stainless steel or rigid polyethylene pipe lines on account of its flexibility, is expected to have a number of uses, particularly in the chemical industry.

Sizes in which the hose is available range from ½ in. to 3 in. bore, and lengths of up to 60 ft. can be supplied. Working temperatures should in general not exceed 60° C., although very low pressure steam may be used for cleansing, provided that the other end of the hose is open to the atmosphere. Maximum working pressure is 50 p.s.i.

Enquiries should be addressed to the Dunlop Hose Division, Team Valley Trading Estate, Gateshead.

Heavy Duty Broom Filling

A new type of heavy duty broom produced by the Star Brush Company is now finding acceptance on farms and in factories, and wherever arduous service conditions are encountered. The brooms are filled with Shalon 214 polystyrene monofilament, supplied by Bakelite Ltd. They have exceptionally good wearing properties and a service life many times greater than that of conventional brooms containing vegetable fibre. In addition, the brooms wear evenly and do not shed their filling. They are completely resistant to moisture and can be left out in wet weather. A further asset is that they can be very easily swilled clean, an important factor in dairies and other locations where hygienic conditions have to be maintained. In general Shalon can be used under any working conditions except where grease or petroleum is encountered during use.

Insulated Bag

Originating in the U.S.A. a new picnic or shopping bag is now being manufactured in this country by The Thermobag Co., Ltd., 124a Brompton Road, London, S.W.3. This bag is manufactured from p.v.c. and has fitted between the outer and the liner an insulating material. In this way it is possible to keep food and drink cool and it is reported that ice cubes can be stored in the bag. Conversely the Thermobag will maintain the temperature of heated goods. It is available in two sizes, 6 in. by 11 in. by 14 in. and 4½ in. by 7 in. by 11 in.

Insulated bag made from p.v.c. by The Thermobag Co., Ltd.

Contemporary Mosaic Tiles

Plysu Sales Ltd., Woburn Sands, Bletchley, Bucks., introduced last month a new mosaic tile. These tiles are injection moulded in polystyrene and are attached to a scrim backing making panels measuring 12 in. by 12 in. containing 256 tiles. The method of attaching the tile to the scrim is by heat sealing over the fabric. Contemporary patterns are included in the panel which is attached as a whole to the wall surface. A mastic supplied by Plysu is used as the adhesive. After 12 hours grouting, using a cellulose type filler can be carried out. The advantages of using this type of mosaic is that it can be put in position in a very short time and requires little skill to obtain a professional appearance. By cutting through the fabric backing with ordinary scissors panels can be made to fit any area or surface. In addition the panel is flexible and can fit around corners or pillars.

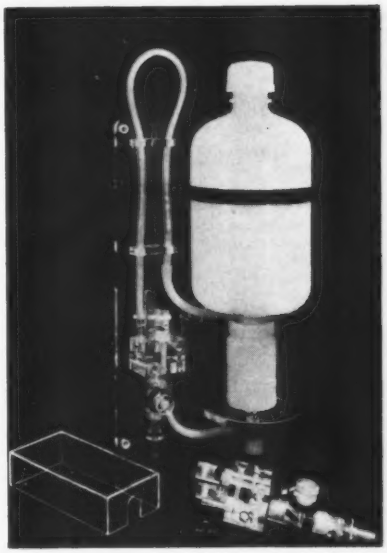
Automatic Drip Regulator in Perspex

A new automatic drip regulator has been produced by R. O. Harris & Co., Ltd., Cambridge Works, Bedford Road, East Finchley, London, N.2, for Condesco Products Ltd.

Made from solid block and rod Perspex, the various parts are machined to engineering precision standards, so attaining the necessary accuracy and perfect regulation of the drips.

The main storage bottle feeds into a smaller one by means of a special connector which ensures a constant head in the latter.

The bottles are polythene—the drip regulator valve is constructed entirely in Perspex. In fact, with the exception of the hydraulic cylinder, its mounting brackets and a small number of screws, the units are constructed in plastic materials. All metal parts are covered and the units are thus virtually unaffected by corrosive materials.



An automatic drip regulator constructed almost entirely from Perspex. The bottles are polythene.

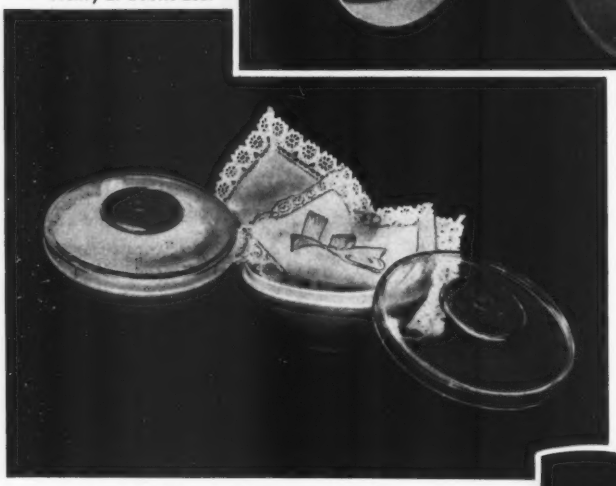
An automatic cut-off valve, operated by a hydraulic cylinder, is interposed between the constant rate bottle and the drip regulator valve, the hydraulic cylinder being connected to the output of the final rinse pump of a bottle washer or similar supply: the minimum operating pressure being 10 p.s.i. Liquid cannot flow from the drip regulator valve until pressure is applied to the cylinder. As soon as the pressure is allowed to drop, the cut-off valve will operate, thus eliminating waste and preventing any excess dosage when using corrosive materials. This ensures that damage is prevented to tanks, etc. The regulators are supplied in 1 gallon and 5 gallon sizes.

(Right) Birkbys Ltd., of Liversedge, Yorkshire, manufacture the ELO mouldings used in the production of the "Variac" autotransformers by Messrs. Zenith Electric Co., Ltd.

"Variacs" are widely used in industry, and laboratory testing, for providing adjustable output voltages, substantially independent of load.

(Left) High-impact polystyrene is being used by the Metal Box Co., Ltd., to make disposable drinking cups called Polycups which may be used for both hot and cold drinks.

(Below) This package for lace trimmed handkerchiefs is moulded from pink pearl polystyrene with a transparent lid having a gold engraved medallion centre. It is moulded by Universal Metal Products Ltd., for Henry E. Cooke Ltd.

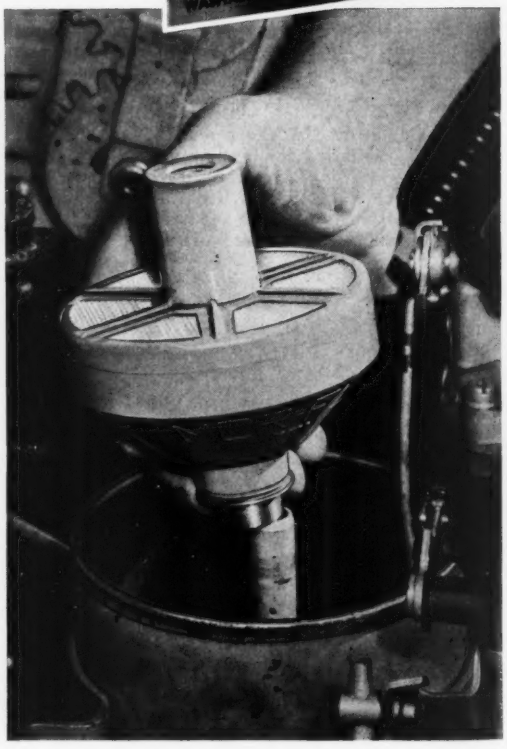


(Below) Plaston doll's feeding and hot water bottle blow moulded in polythene by Shipton Plastics Ltd., Ferndown, Northwood Hills, Middlesex.

(Below centre) The polythene bottle which is the new pack for Milton denture powder has been designed and produced by the Metal Box Co., Ltd.

(Below) Cellobond polyester resin reinforced with glass fibres has been used in the latest fire engines constructed by H.C.B. Engineering Ltd. The sections in this material include the whole of the front and windscreen surround, cab roof and bell housing and the instrument panel and engine cowling shown.

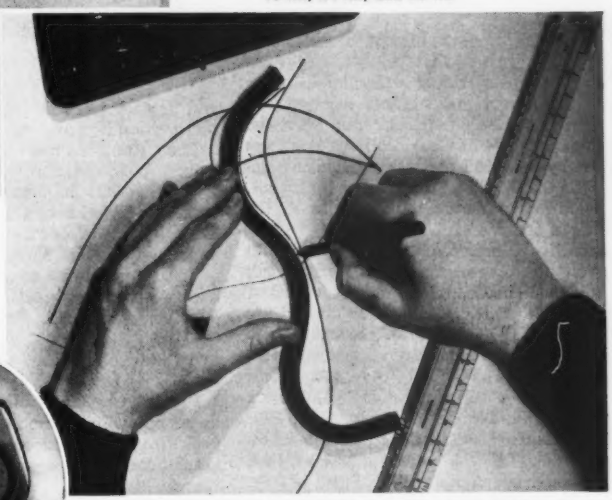
(Right) A new automotive oil filter cartridge offers users important improvements over conventional types in both design and material. Said to be the first successful plastic filter produced in the United States, the Mor-Flo filter capitalizes on the residual static electricity in Tenite butyrate plastic from which its body and element retainer are moulded, as an added means of retaining fine settlings and preventing their re-circulation in the engine.



(Left) The Stelvetite p.v.c. coated steel work tops of Ezee Kitchen equipment as shown for the first time, at the Ideal Home Exhibition, Olympia, London.

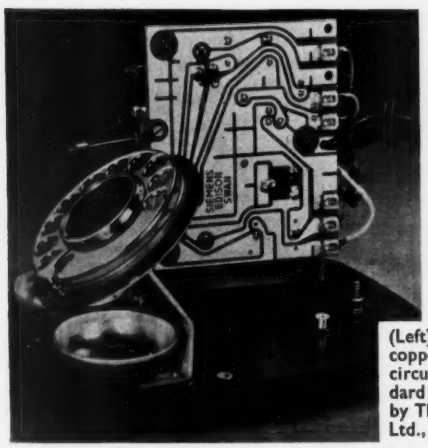
(Below) C. & C. Marshall Limited, of London, N.20, have developed with W. H. Harling Limited the Centex Flexible Curve, which has been designed primarily for use in drawing offices. An important feature of this curve is the bead running around one edge, which is only practicable to produce as a plastic extrusion, and which permits an ink line to be drawn smudge free. These curves are made in standard lengths of 12 in., 18 in., 24 in., and 36 in.

(Above) The new Halex polythene hot water bottle which it is claimed can be used for boiling water without any ill effects and will also retain its heat more than twice the length of time of the old rubber kind.



(Left) Illustrated is a handle with a full hand grip which the Plastics Division of Universal Metal Products Ltd., are making for Metropolitan-Vickers Electrical Co., Ltd. The handle is used on heavy industrial switchgear and is moulded from glass-fibre premix material.

(Below) Model cars that duplicate in body detail are the red-and-white Fairlane convertible and the blue-and-white Fairlane de luxe sedan shown here. Moulded of Tenite acetate plastic.



(Left) An application of Paxolin copper faced laminate for printed circuits. It is available in two standard grades and is manufactured by The Micanite & Insulators Co., Ltd., Blackhorse Lane, Walthamstow, London, E.17.

Automation Equipment

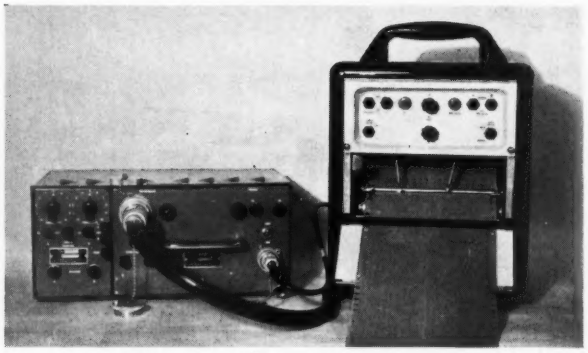
Hardness Testers.—The Pocket Hardness Tester Type M 223 operates on the Shore principle and is built to comply to ASTM Standards. The type M 223 is provided with a scale having a length of 100 mm (4 in.) giving readings in per cent. (Shore degrees) with divisions of 1 to 1%. Measurements are carried out by pressing the feeler pin against the test sample until the base of the instrument lies flush on the surface being tested. The hardness of the specimen is then indicated on the scale in percentage (Shore degrees). A metal cap protects the feeler pin when the instrument is not in use. The large Hardness Tester Type M 220 operates on similar principles to the Brinell hardness tester for metals. It conforms to the DIN as well as to the American Standards.

A ball of definite diameter is pressed into the test piece, under an application of first an initial load followed by the main load of 1000 g. The full load should be applied for 10 seconds and the depth of the indentation has to be read off on the scale of the instrument in 1/100 mm. The depth of the incision gives the so-called "softness value" and is a measure of the hardness of the material.

Unless otherwise specified, the hardness tester is supplied with an exchangeable sphere of 10 mm. diameter and an initial load of 50 g. For the adaption to other standards, other exchangeable spheres and additional initial loads can be supplied.

Engineering & Scientific Equipment, 33 Minster Road, London, N.W.2.

Quick-Response Recorder with Amplifier.—These continuous roll chart instruments incorporate two quick response movements and record electrically on Teledeltos paper. The movement zero may be set in any position, and a marker pen is incorporated. Internal illumination is provided.



The Evershed quick-response recorder and amplifier on which records can be taken up to 25 c.p.s. with an amplitude error of less than 10%.

The CRD 5 has chart speeds of ½, 1, 3, and 6 in. per second, and the CRD 6 speeds of 2, 4, 12, and 24 in. per minute. These speeds are selected by a lever. The front of the recorder hinges open to form a run-out chute for the paper and a writing surface.

The amplifier unit comprises a power pack and two amplifiers, and an 18-core connector 5 ft. long is provided. Power requirements are 115/230 volts 50/60 cycles A.C. (140 watts) and 15–20 volts D.C. (3 watts) for the marker pen.

Records can be taken up to 25 c.p.s. with an amplitude error not exceeding 10% for a peak to peak deflection of 1½ in. At smaller amplitudes the frequency response is proportionally higher.

Under static conditions the linearity is within ± 3%, and after warming up the drift is negligible.

The sensitivity is ± 5 volts for full scale deflection of ± 1½ in., and can be adjusted down to zero by a potentiometer control. With this control in circuit the input impedance is approximately 50,000 ohm, and 2 megohms with the control switched out.

Evershed & Vignoles Ltd., Acton Lane Works, Chiswick, London, W.4.

Electronic Temperature Controller.— The Sifam Pyromaxim Electronic Temperature Controller now generally available, is the result of careful development and thorough testing under rigorous working conditions.

The mirror scale of more than 8 in. length ensures legibility and accurate reading of temperatures to better than 1%. The calibration complies with B.S.S.1041 recommendations and the control response is within ¼%.

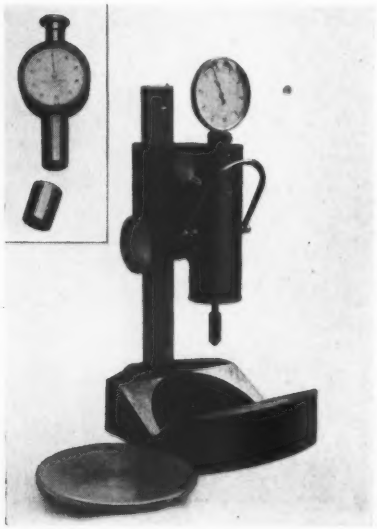
The measuring galvanometer employs a powerful Alcomax magnet surrounding a moving system which swings between spring mounted sapphires. Automatic cold junction compensation is a standard provision. This movement and its pointer are completely free of mechanical stress or interference.

A simple electronic circuit provides the link between measurement and control which instantaneously operates an enclosed relay rated at 3A and 250V A.C. non-inductive load.

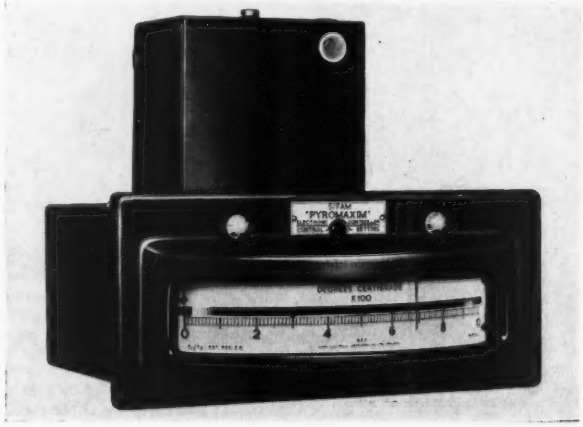
A notable feature is the plug-in arrangement of the electronic amplifier unit which can be removed and replaced in a few minutes thus facilitating installation and maintenance.

General robustness and dependability have been given special attention and the Pyromaxim is available in ranges from 0–200° C. to 0-1600° C. or Fahrenheit equivalents. Calibration can be made for any type of thermocouple, and it is supplied for either flush or wall bracket mounting for use with supply voltages of 110/220/240 A.C.

Sifam Electrical Instrument Co., Ltd., Leigh Court, Higher Lincombe Road, Torquay.



(Left) The M 223 pocket hardness tester (inset) and the M 220 large hardness tester.



(Right) The Pyromaxim electronic temperature recorder.

TALKING SHOP . . .

Railway Modernization. Visitors to Liverpool Street Station recently may have seen one of the new diesel-electric locomotives built by Brush Traction Ltd. These powerful engines have been on proving trials and will eventually operate the long-distance expresses on the Eastern Region out of Liverpool Street. BX Plastics Ltd., have played a part in their construction, for Isoflex is used in the driver's cabin for thermal insulation and anti-drumming.

* * *

Education in Plastics. A donation of £1,000 has been made by Associated Iliffe Press Limited for education and research in the plastics field. A trust has been set up with four trustees namely Mr. H. V. Potter, Mr. C. C. Last, Mr. M. B. Punfield, and Mr. C. E. Wallis. The trustees can in addition co-opt the chairman and hon. secretary of the Plastics Industry Education Fund for the purpose of selecting suitable candidates for awards. The donation will be administrated by the trustees and does not come under the jurisdiction of the Plastics Industry Education Fund committee who normally control the use of such funds.

* * *

Federation Annual Luncheon. There was a record attendance at the 23rd Annual Luncheon of the British Plastics Federation held at the Dorchester Hotel, where the guest of honour was Rt. Hon. Lord Mills, K.B.E., Minister of Power. After an excellent luncheon members and guests listened with pride but also with modesty to the Chairman, Mr. N. B. Punfield, who spoke of the continued expansion of the plastics industry during the past year. He paid particular attention to the efforts of the material manufacturers through their research and development departments in producing new materials and thus widening the field of application of plastics.

Mr. Punfield then went on to pay a tribute to the Federation which provides a centre for the exchange of information and co-operation between member firms to the greater good of the plastics industry.

After welcoming the guests, Mr. Punfield then proposed their toast. Replying for the guests Lord Mills complimented the plastics industry on the trebling of its output in the last 10 years and continued by reviewing the financial position of the country as a whole and exhorting his audience to maintain this progress in the future in which he wished the industry continued success.

* * *

Sir James Swinburne. Many people in the plastics industry were saddened to hear of the death of Sir James Swinburne on March 30. One of the pioneers of our industry, he was a man of exceptional talents, coupled with a deep humanity. To mark his 100th birthday in February, our March issue (page 78) carried an appreciation of his career. For many years he was chairman of Bakelite Ltd. With his passing one of the major links with the early days of the plastics industry has been broken.

* * *

Scooter Screen. From BX Plastics Ltd., comes an interesting news item, the use of clear Cobex for scooter screens. Made by Stratford Auto Components Ltd., these screens have been tested up to 80 m.p.h. No drumming was experienced. Cobex has proved excellent in use and has met an exacting U.S. specification for clarity and non-discolouration. The material is also non-flammable.

* * *

Plastics and Polymer Group. On April 15–17, a Silver Jubilee Symposium was held at Senate House, London University, by the Plastics and Polymer Group of the Society of Chemical Industry. The chairman of the Group is Mr. C. E. Hollis, and the three-day proceedings were chaired by Dr. V. E. Yarsley, Mr. C. G. Garton and Dr. L. R. G. Treloar, in turn. The theme of the Symposium was the physical properties of polymers. Over 300 delegates attended, and 19 papers were presented. Synopses appear on pages 167–168.

On the evening of April 16, a celebration Dinner and Dance was held at the Savoy Hotel. In the chair was Mr. Hollis, and the guest of honour was Sir Robert Robinson, O.M., F.R.S., accompanied by Lady Robinson. Also present were 12 past chairmen of the Plastics and Polymer Group, and Sir William and Lady Ogg. Sir William was representing the President of the Society of Chemical Industry.

Scooter screen made from transparent Cobex vinyl sheet.

Yarsley Research Laboratories Ltd. Following the announcement recently that Dr. V. E. Yarsley (Research Laboratories) Ltd., was undergoing a change of name to Yarsley Research Laboratories Ltd., we visited the organization at its headquarters in Chessington, Surrey, to see the extensions to the resources of the organization since we were last there some years ago.

Dr. Yarsley formed his practice in 1931. Although in the early days he was mainly interested in cellulose plastics, he extended his practice to cover all materials. He also established a testing department, now known as Yarsley Testing Laboratories Ltd., officially recognized by the A.R.B. and A.I.D. The staff of the group now exceeds 100, including a manufacturing company, Lucent Products Ltd. This last-mentioned organization produces Polectric SM11, a styrene copolymer developed principally for use as a high temperature dielectric, and also offering possibilities as heat resistant light filters and for steam-sterilizable transparent articles. Below are some recent photographs taken at the Laboratories.

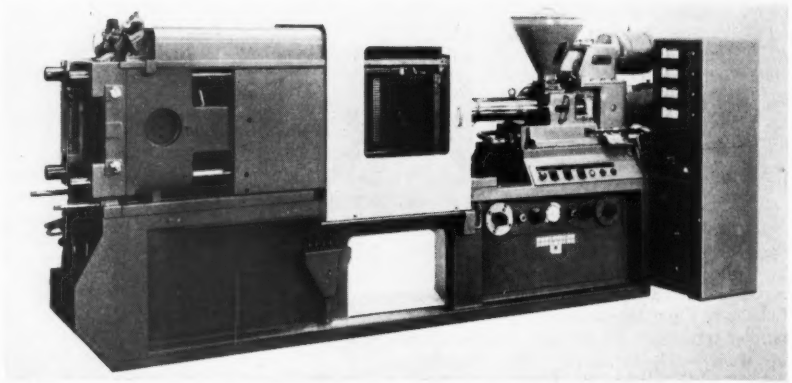
PLASTIKON.

(Left) Tensile testing of rubber in the mechanical testing laboratory and (right) washing high softening styrene copolymers at Yarsley Research Laboratories.

Machines for the Industry

The Ankerwerk Single Screw Injection Machine

Much interest has been aroused by the use of a screw for plasticizing in the cylinder of an injection machine. This presents many problems and the successful solution of these has resulted in the Ankerwerk injection machine. This machine, which is sold in this country by Aldersley Agencies Ltd., 32, Buckingham Palace Road, London, S.W.1., is described fully in the following pages in which will be seen a complete cut-away drawing of it.



The Ankerwerk injection moulding machine fitted with a single screw.

THOSE interested in the injection moulding world have been watching closely its developments concerned with Ankerwerk Gebr. Goller of Nuremberg, Germany, who recently introduced a completely new type of injection moulding machine. Experience which has now been gained by moulders shows that a considerable advance has been made with the introduction of this type of machine which employs the principle of screw plastification, but contrary to the machines of this type known for some time, a single screw is employed. Although only a single screw is involved, it has been possible to obtain exceedingly high plasticizing capacities and to build up the necessary injection pressures. Tests with various materials have shown that heat transfer, homogeneity, as well as rate and degree of gelling, are such that the most sensitive materials, such as rigid p.v.c. polyamides, polycarbonates and polyvinyl carbazol, etc., can be moulded successfully and without difficulty.

Experiments designed to show the degree of mixing taking place in the cylinder have also provided most interesting results. For instance, parts have been moulded in low pressure polythene, using granules consisting of 97% natural material and 3% pigmented yellow. The resulting mouldings were perfect yellow parts. Similar experiments with dry pigments instead of master batch provided equally good results.

Both the shot capacities as well as the plasticizing capacities of these machines are a number of times higher than those which can be obtained on "normal" machines of the same size.

As can be seen in Table I, Ankerwerk have, in the meantime, developed a whole range of this type of machine so that a suitable unit is now available in every size.

Construction

For a detailed description, the Ankerwerk single screw injection moulding machine can conveniently be divided into five basic parts:

(1) Machine Frame. This is of robust and well dimensioned welded construction. The main and cross members of the frame are built up of strong, welded girders (1). The steel plates welded on to the frame add additional stability. Large openings with doors allow easy access to all built-in equipment.

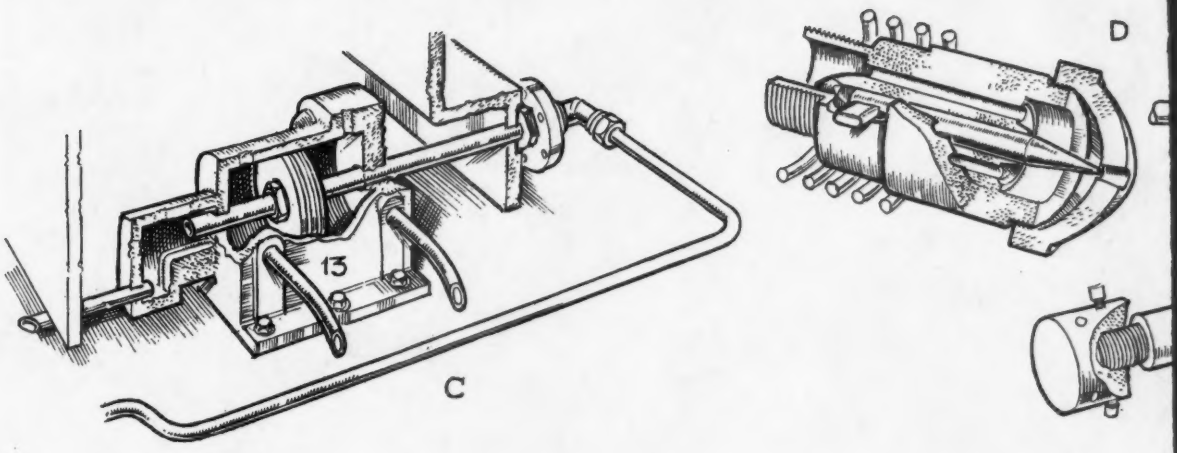
(2) Mould clamping unit. The mould clamping unit is mounted on the machined face of the frame. The unit consists of the basic frame (2), the moving platen (3) and the fixed platen (4). The moving platen runs on four ground and hard chromed tie bars (5). The platen moves in and the whole toggle clamp system is equipped with bronze bushes automatically lubricated by the lubricating pump (6). The weight of this platen and its mould half is supported on the frame by rollers running in roller bearings (7). One set of gears operated by one handle is used for adjusting the length of the tie bars (8). It is possible to equip the machine with different gear ratios or an electric motor which replaces the handle. The whole clamping unit can be moved in relation to the injection unit by means of two spindles (9). The toggle clamp bearings are installed in the clamping unit frame (2). The hydraulic cylinder (10) mounted in the unit pulls the toggle clamps down by means of a very heavy bolt (Sketch A), thereby closing the mould. Also mounted in the centre of the unit is the ejector block (11) which is so dimensioned that it can be used to support the unwinding spindle of certain types of moulds. For damping the ejection movement, two sets of springs support the dampers (12) and Sketch B. The whole construction has been designed to ensure that during the mould closing cycle all strains and stresses are taken up only by the mould clamping unit; the machine frame only supports the weight and is not called upon to take up any additional stresses.

(3) The injection unit. The injection unit is mounted on rollers and is moved forwards and backwards by a hydraulic cylinder (13). The hydraulic cylinder (14) provides the power for the axial displacement of the screw and is flanged to the rear of the screw drive unit casing (15). Its supply of high pressure oil is provided by means of a pipe through the cylinder as shown on Sketch C. In this way it is possible to dispense with the otherwise necessary high pressure hoses. An electric motor (16) provides the rotary motion of the screw through a set of reduction gears (17). This set is interchangeable so that any desired speed of rotation may be obtained.

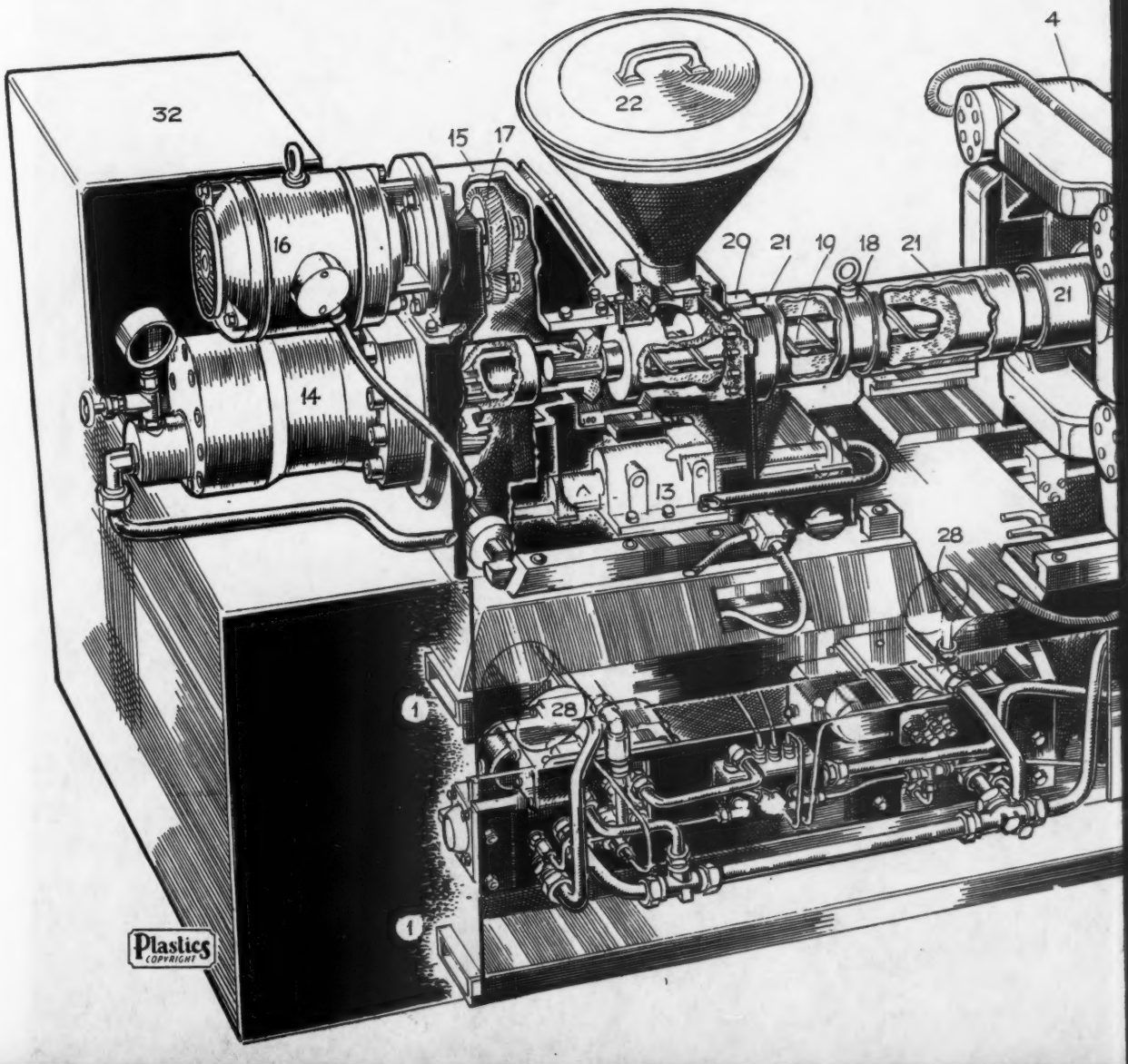
The plasticizing cylinder is flanged to the front part of the drive unit casing (18); the screw (19) rotates in this cylinder. In order to obtain the specific pressure required for any set of conditions, four different cylinders are produced in standard series. In addition, two types of screw are available—for low and high viscosity materials. Two types of nozzle can be supplied when these are required and particular attention has been paid to the easy flow of the material through the nozzles. This can be seen in Sketch D showing a needle nozzle. The cylinder and screw can be removed from the unit after unscrewing the clamping rings (20), simply by pulling them forward. The plasticizing cylinder (21) is externally heated electrically in four zones.

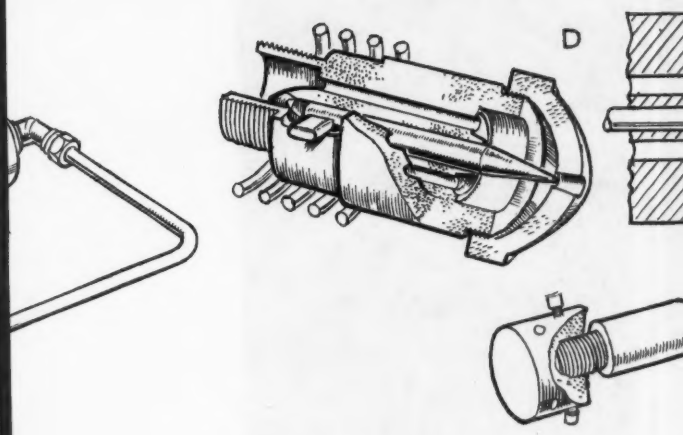
KEY TO DRAWING

1. Welded girders.
2. Mould clamping frame.
3. Moving platen.
4. Fixed platen.
5. Tie bars.
6. Lubricating pump.
7. Roller bearings.
8. Adjusting gears.
9. Spindles.
10. Hydraulic cylinder.
11. Ejector block.
12. Dampers.
13. Injection movement cylinder.
14. Axial displacement cylinder.
15. Screw drive unit casing.
16. Screw electric motor.
17. Reduction gears.
18. Drive unit casing.
19. Screw.
20. Clamping rings.
21. Plasticizing cylinder.
22. Hopper.
23. High pressure pump.
24. Normal pressure pump.
25. Oil tank.
26. Electric motor.
27. Maximum pressure valves.
28. Regulating valves.
29. Water cooler.
30. Oil filter.
31. Air filter.
32. Control cabinet.
33. Pressure reducing micro switch.
34. Pressure increasing micro switch.
35. Contact ring.
36. Scale.
37. Return stroke micro switch.

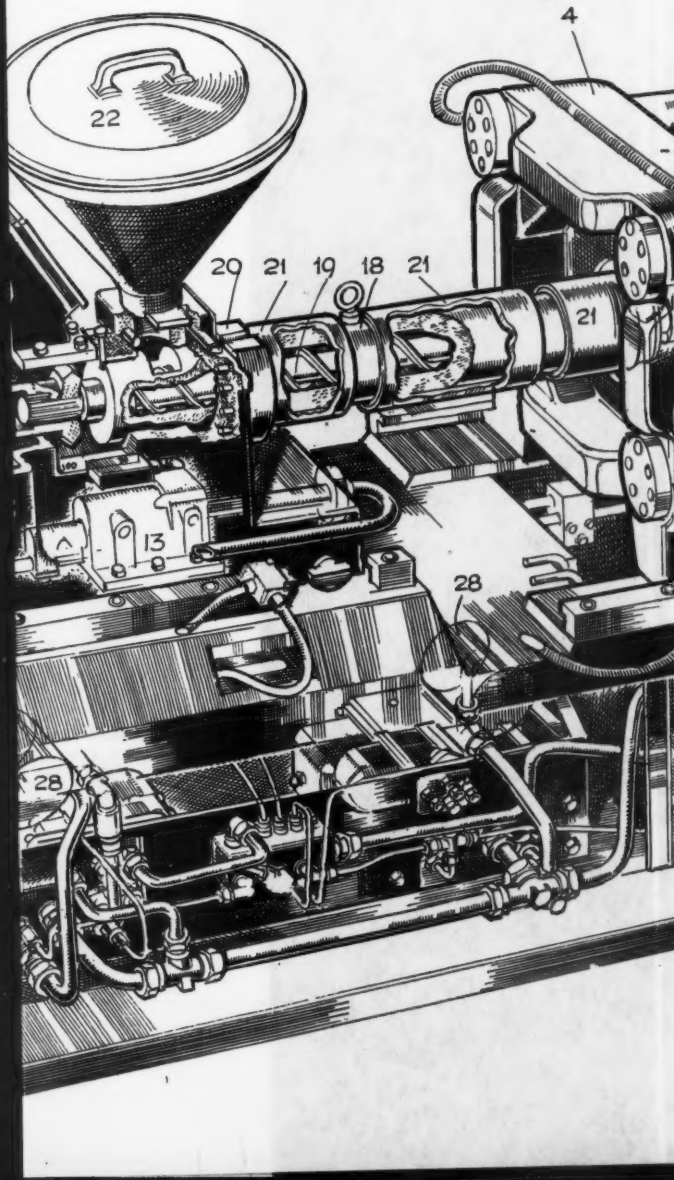


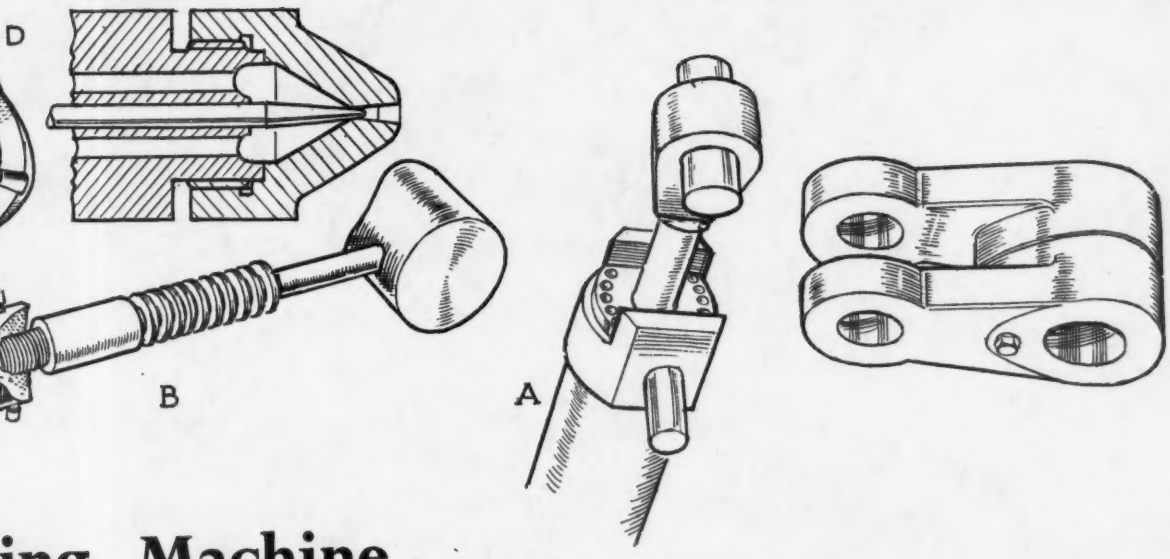
The Ankerwerk Injection Moulding



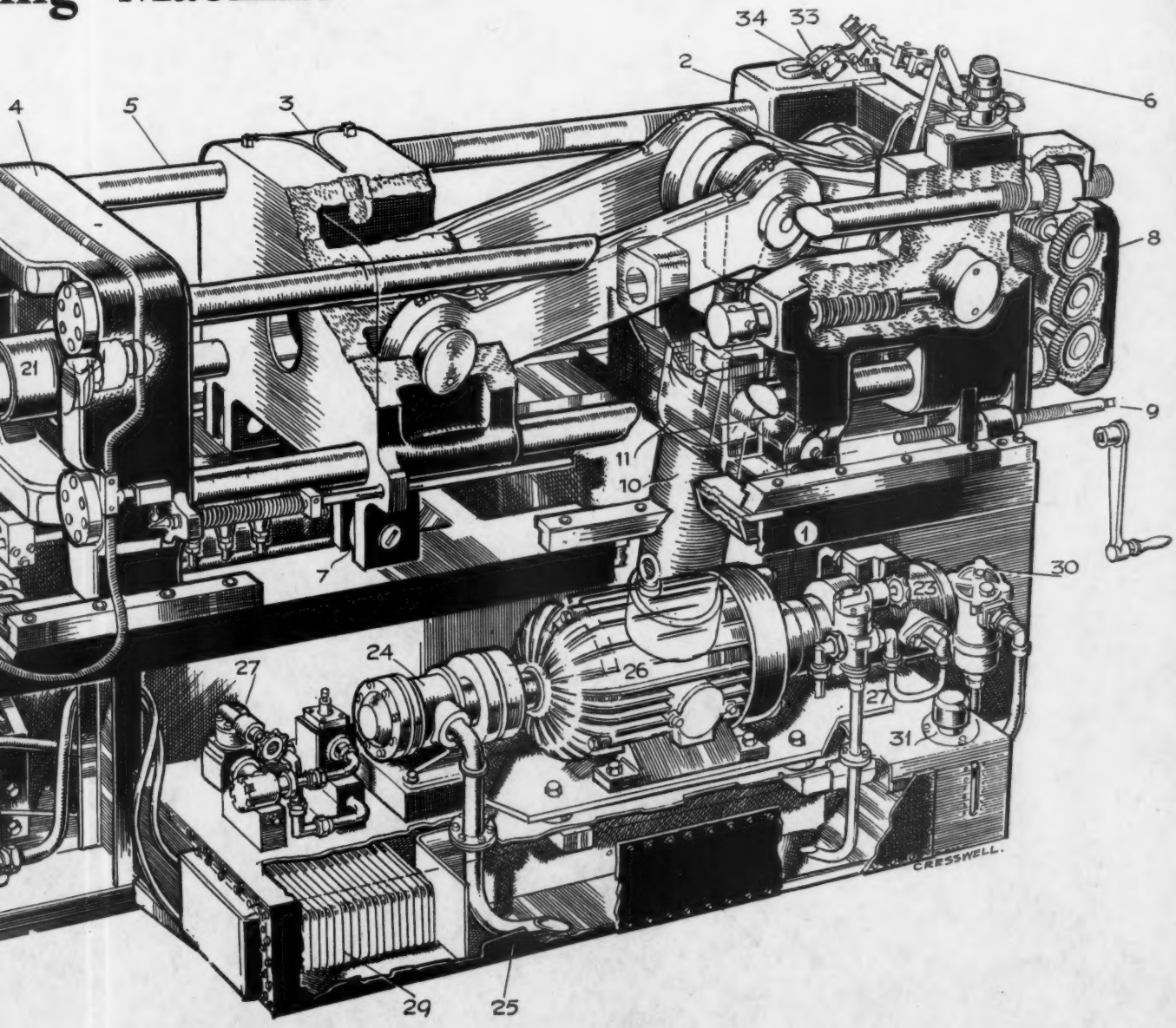


Injection Moulding





ing Machine



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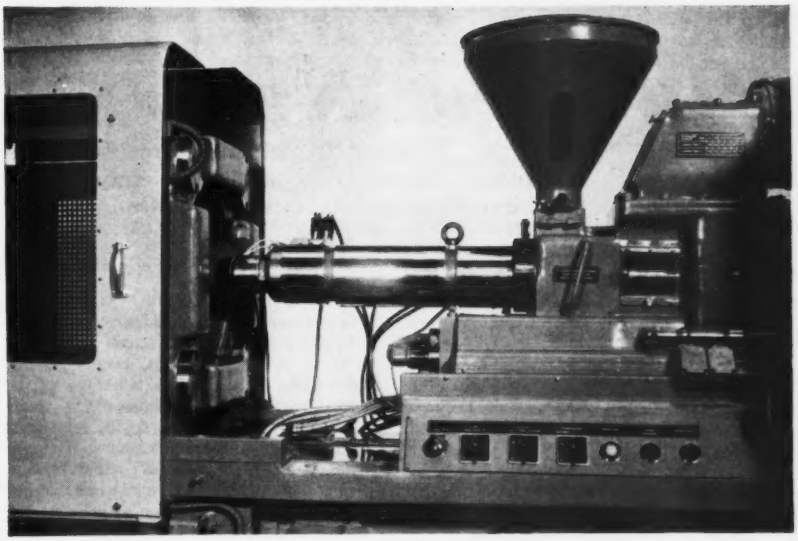


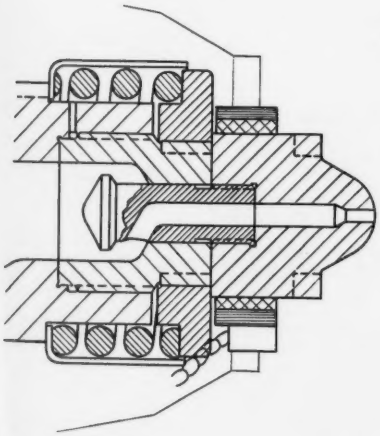
A closer view of the injection cylinder and nozzle.

The temperatures can be regulated automatically by means of accurate instruments.

The granules fall directly from the hopper (22) into the screw and are carried forward by it and plasticized in the process. The various movements of the screw are controlled by timers and micro switches which can be set to provide many combinations over a wide range of conditions. For instance, actual injection can take place with the screw rotating or not rotating, or the screw can be set to start rotating only after completion of the time of the initial injection pressure. The quantity of material taken into the cylinder at each cycle is part of the function of the screw during its return strokes, the length of which can be regulated by means of a micro switch (37) which can be set and operated in conjunction with the scale (36).

(4) The hydraulic system. The machine is operated by a Vickers oil hydraulic system. A two stage high pressure pump for 140 atm. (approximately 2,000 p.s.i.) (23) and a normal pressure pump for 70 atm. (approximately 1,000 p.s.i.) (24) are mounted on a large oil tank (25) and are driven by the same electric motor (26). Two maximum pressure valves (27) protect the whole system. Through built-in regulating valves (28), the mould closing speed as well as the injection speed, can be infinitely varied, independently of one another. The oil in the hydraulic system is cooled by the water cooler (29) built into the tank. The oil and air are filtered (30 and 31). In this way contamination of the oil is avoided, thereby prolonging its life.

(5) Electrical equipment. The electrical switchgear is housed in a separate control cabinet (32). All instruments can be seen at a glance from the operating side. The timers are covered by a Plexiglas door which can be locked to eliminate unauthorized operator interference. The levers and switches for the manual operation of the machine are mounted in a slanted control panel fitted to the machine immediately underneath the injection unit; there is also an emergency stop switch which, when operated, will immediately stop all parts of the machine in whatever position they may be at that moment. The same applies to the guard mounted on rollers over the platens. Should this be opened only a fraction of an inch, the whole machine will stop immediately.



Detail of the injection nozzle.

Operating Sequence

A single cycle would develop as follows:

Oil at 1,000 p.s.i. from both pumps will be pumped into the mould closing cylinder and the mould will close. Just before the two mould halves touch, this pressure is reduced to approximately 120 p.s.i. by means of a micro switch (33) to make certain that the mould would not be damaged should some particle be between the mould halves. If the mould is clear, the pressure is increased to 2,000 p.s.i. by micro switch (34) and the toggle clamps are now pressed home. The oil will now be brought into the cylinder (13) which will move the injection unit forward and the nozzle will rest on the mould. The screw is then pushed forward by cylinder (14) and the material injected. The holding pressure can be reduced in three steps by timers to avoid internal stresses in the moulding. The screw is then rotated and the material gelled for the next shot. As the nozzle is now closed, the molten material cannot be extruded and the screw is therefore pushed back against the piston of cylinder (14). The oil pressed out of the cylinder has to pass through a regulating pressure valve. The back pressure which can thus be set to suit circumstances has an important bearing on the internal friction in the material now being gelled. When enough material has been gelled for the next shot, i.e. when the screw has been pushed back far enough, the contact ring (35) will operate the adjustable micro switch and the screw will stop. By this method of dosing, the density or weight of the material have no bearing on the amount of material gelled as this is clearly a matter of volume. During this period the injection unit will have returned to its original position which is, of course, variable. For certain processes it is possible to leave the injection unit permanently resting against the mould.

The timer controlling the cooling period will now operate and both pumps will pump oil to open the mould quickly. The amount of oil being pumped will be reduced immediately before ejection to damp this movement. If the machine is set for fully-automatic operation, it will now start on the next cycle. If it is set for semi-automatic operation, it will stand in this position until a switch is operated.

Acknowledgment

We wish to acknowledge the assistance and co-operation of Ankerwerk Gebr. Goller of Nuremberg and Aldersley Agencies Ltd. in the preparation of this article.

TABLE I. RANGE OF ANKERWERK MACHINES

Type	Shot capacity		Mould clamping pressure	Maximum stroke of clamping rams	Maximum Daylight opening	Maximum moulded area	Opening between tie bars	
	Screw C	Screw D (Polythene)					Horizontal	Vertical
	cu. in.	cu. in.	tons	in.	in.	sq. in.	in.	in.
V 15–75	8.85	13.11	75	11.81	22.83	54.25	11.81	5.51
V 19–130	15.25	21.96	130	14.17	27.95	93.00	14.17	11.81
V 19–200	15.25	21.96	200	15.74	29.92	139.50	16.14	16.14
V 24–200	19.52	25.62	200	15.74	29.92	139.50	16.14	16.14
V 24–350	19.52	25.62	350	19.68	37.00	217.00	19.68	19.68
V 40–350	61.02	79.32	350	19.68	37.00	217.00	19.68	19.68
V 40–550*	61.02	79.32	550	27.55	51.16	341.00	27.55	27.55
V 74–550*	115.94	183.06	550	27.55	51.16	341.00	27.55	27.55
V 74–800*	115.94	183.06	800	35.43	66.92	496.00	41.33	41.33
V 90–800*	195.27	317.31	800	35.43	66.92	496.00	41.33	41.33

* Ankerwerk-Krauss Maffai Constructions.

Plastics News

Plant and Equipment, Materials, Processes, Company News, Technical Literature, Exhibitions, Personal Notes and Meetings.

HORIZONTAL BAND-SAWING MACHINE.—For the plastics industry, an inexpensive universal machine, specially developed by F. J. Edwards Ltd., 359–361 Euston Road, London, N.W.1, to perform the cutting-out of plastic shapes after vacuum forming; to handle both large and small quantities.

The machine is a band-saw with the band travelling horizontally in a fixed plane, whilst the sheets of plastic material are firmly clamped to a sliding table which moves on rollers in a plane at right angles to the saw band. This special steel saw band travels over two pulleys, one of which is driven by an electric motor.

The clamping frame is secured to the table by two spring-loaded hinges and one central clamping lever. This arrangement enables the even clamping of sheets of various thicknesses up to $\frac{1}{4}$ in. and up to a size of 24 in. × 24 in. The height of the table is adjustable in relation to the saw band by a wheel beneath the table, whilst the feeding mechanism is operated by the side handwheel.

A special feature of this machine is that very thin sheets (approximately ·005 in. thick) can be cut by using a mask from cardboard, plywood or sheet metal, the size of the frame, with cut-outs to allow the shapes to project through. This mask looks similar to the plastic sheet *after* the shapes have been cut out and it is clamped down under the clamping frame together with the plastic sheet. To achieve even firmer clamping, runners are provided which act under spring pressure and are adjustable sideways, so that they can be located between the shapes.

A built-in welding attachment can be supplied, so that broken saw blades can be butt-welded on the spot.

AUTOMATIC WELDING MACHINE.—With this high frequency machine it is possible to weld thermoplastic materials direct from a roll on a fully automatic cycle, including feed of the material and ejection of the finished work. The machine has a special table which incorporates a device for feeding the material under the welding head. The pitch of the feed can be adjusted so that for each case the best possible conditions can be selected in order to reduce the waste of material to a minimum. In addition to the fully automatic cycle, the machine can also be operated on a semi-automatic or single-cycle basis. In case of damage to the work being welded the high frequency current is switched off immediately, the press withdraws and is locked in its upper position, while the table removes the last welded object out of the press.

Control of feed is fully electronic and the press as well as other parts of the machine are actuated by air cylinders. The generator can be delivered in capacities ranging from 1 to 6 kV. In common with the semi-automatic welding machines built by this manufacturer the fully automatic machine allows replacement of the generator by one of greater capacity, when required, without any alteration being necessary either to the press or the feeding device. The construction of this welding machine with automatic feed in the horizontal plane is such that these machines can be used either in combination with semi-automatic types or on their own to form a completely automatic plastic welding line with electronic control from a centralized governing panel. The machine is manufactured by Maxinec N.V., Boterstraat 12, Schiedam, Holland.

ROTARY VACUUM PUMP.—The latest addition to the Metrovac range of rotary vacuum pumps is the type DR210 comprising two single-stage, vane-type pumps mounted in a single oil tank and driven by a common shaft. The equipment, therefore, has the pumping characteristics of two single-stage pumps with considerable saving in space.

The pump is in good dynamic balance, the centre lines of the sliding vanes in the two rotors being arranged mutually at right angles: vibration is therefore greatly reduced. Operational noise has been kept to a minimum by the use of a quiet type of exhaust valve assembly and helical reduction gears.

Like other small rotary pumps in the Metrovac series, the DR210 is fitted with an oil baffle, a sight glass, gravity drain plug and a pressure drain connection on the top cover. For use in situations where a gravity draining of the pump case is impracticable, a special pressure drain attachment can be supplied.

General

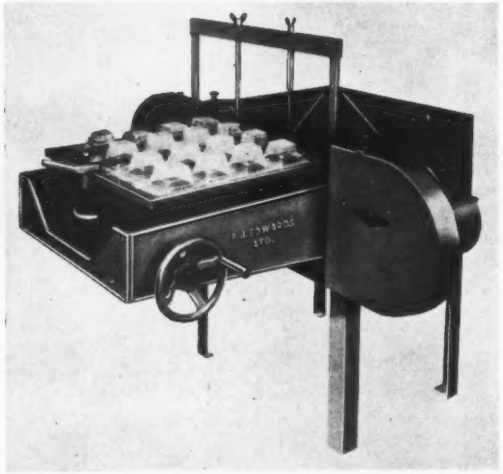
Exporting Licensing Control Consolidation Order.—The Board of Trade announce the issue of the Export of Goods (Control) (Consolidation) Order, 1958. This new Order incorporates the 1956 Consolidation Order and subsequent amendments for the convenience of exporters. It re-enacts the provisions of those orders.

A few drafting changes have been made and in particular the descriptions of Chemicals in the first schedule have been revised in the light of current practice. There are no changes of substance.

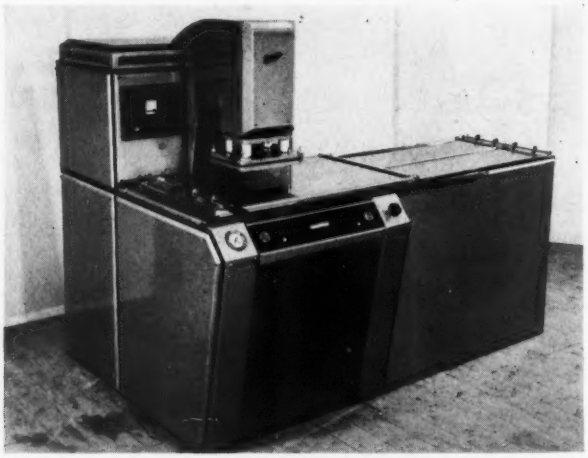
Price Reduction.—The Pittsburgh Plate Glass Company, Pittsburgh 22, Pa., U.S.A., announce that they have made substantial reductions in the price of their Fibre Glass Roving in sizings Chrome Complex and Silane. The Chrome Complex finish is applied in hard, soft or medium Chrome.

Further details regarding these materials can be obtained from their distributors in the United Kingdom: Omni (London) Limited, 35 Dover Street, London, W.1.

Rigidex Polyethylene. — British Resin Products Ltd. announce that the high density polyethylene which they are marketing



The horizontal band-sawing machine developed by F. J. Edwards Ltd. for trimming vacuum formed articles.



The fully automatic high frequency welding machine manufactured by Maxinec N.V. of Holland.

The Ceewrite depth indicator.

on behalf of British Hydrocarbon Chemicals Limited, will in future be sold under the trade mark Rigidex.

Rigidex is made by a process developed by the Phillips Petroleum Company who have licensed the manufacturing rights to British Hydrocarbon Chemicals Limited, a company jointly owned by The Distillers Company Limited and The British Petroleum Company Limited.

The following personnel have been appointed in connection with the development of the sales of Rigidex:— Sales Manager: J. D. Winston; Asst. Sales Manager: G. E. H. Smock; Development Manager: D. N. Davies; and Service Manager: P. Brown.

Smoke-Alarm Meters.—A. M. Locke & Co., 2, Dension Buildings, 79 Union Street, Oldham, Lancs., have recently brought out two new versions of their smoke density instruments. The first of these, type SA1, is suitable for chimneys up to 10 ft. in diameter and gives an alarm when the smoke passing the stack exceeds a preset amount. The second, the MF2 provides for a remote indication and recording of smoke density as well as an alarm when dark smoke is emitted.

Longitudinal Depth Indicator.—The production of accurate length and depth in a longitudinal direction is a major difficulty in lathe work. The Ceewrite Indicator has been designed to make it possible to obtain any number of lengths and depths over the whole working length of the lead screw to within limits of .001 in.

The Indicator is manufactured in eight models, with either fractional or decimal dials, and various settings. Full details are obtainable from the Small Tools Department, Alfred Herbert Ltd., P.O. Box No. 30, Edgwick Works, Coventry.

Golf Results.—The results of the last meeting of the P.I.G.S. at Beaconsfield Golf Club on Tuesday, April 15, 1958, were: "Robert Hartley" Prize: Winner, C. Parkinson (68 nett); runner-up, G. V. Cox (69 nett). "Austerity" Cup: Winner, C. Parkinson (74 gross). Visitors' prize: Winner, R. S. Ellis (72 nett). "Arrow Electric Switches" Trophy and "Steuart" Trophy: Winners, T. S. Crabtree and P. Morgan (37 points); runners-up, D. Sullivan and E. A. Smee (34 points), after a tie with C. Parkinson and B. C. M. Skinner and G. G. Small and R. Wood. Visitors' prize: Winners, C. J. French and R. H. Vesey (31 points); runners-up, F. C. Pullen and J. L. Hardy.

Polystyrene Film.—Monsanto Chemicals Ltd. announce that they will sell Polyflex biaxially-oriented polystyrene film with effect from May 1, 1958.

The more important applications of Polyflex are in the packaging and photographic industries and in the plastics industry where it is used for imparting a high gloss finish to extruded toughened polystyrene sheet.

It can be supplied in thicknesses varying from one-thousandth to twenty-thousandths of an inch.

All inquiries should be made to Monsanto Chemicals Limited, Technical Products Group, Monsanto House, 10–18 Victoria Street, London, S.W.1.

Designs of the Year.—One of the 20 products selected for the Design of the Year Award is the Ekco baby bath illustrated on this page. The bath is moulded in polythene and the stand is made of wood. The whole has been designed by M. O. Rowlands of Ekco Plastics Ltd., and was highly commended by the selection panel.

The Design of the Year Awards are to become an annual event and a regular feature of the Design Centre's programme. Only products which have been exhibited at the Design Centre are eligible for the Award.

The baby bath moulded by Ekco Plastics Ltd., which has been given a Design of the Year award.

New Insulating Materials.—From the Micanite and Insulators Co., Ltd., of Black Wharf Lane, Walthamstow, London, E.17, comes news of some new products developed by this company. The first of these is a slot insulating material made from Micanite and faced with Melinex. The second is ethoxyline varnished glass which is available in thicknesses from .004 in. to .010 in. This material is suitable for class F insulation applications. Finally this company is supplying Samica which is a paper-like material manufactured entirely from selected grades of mica.

Water Chilling Unit.—To meet an increasing demand from Architects, Air Conditioning Engineers and Industrial users of Chilled Water, The Lightfoot Refrigeration Company Limited, of Wembley, Middlesex, have developed a new range of packaged water chilling equipment. These units are available in graduated capacities from 10 to 100 h.p., and are specially designed to save space, and to reduce installation time and expense to the minimum.

Benzoguanamine.—As announced at the 10th Technical Exhibition organized by the Oil and Colour Chemists Association, British Oxygen Chemicals Limited are now offering benzoguanamine on behalf of Tennessee Products and Chemicals Corporation of Nashville, Tennessee, U.S.A.

Benzoguanamine (2, 4 diamino, 6 phenyl triazine 1, 3, 5) offers interesting properties to the manufacturers of resins for stoving finishes. Benzoguanamine is in effect a substituted melamine, but the presence of the phenyl group modifies the characteristics of the resin in several ways.

Plastics for Designers.—The Design Committee of the Plastics Institute under the chairmanship of Mr. R. P. H. Gillot arranged a one-day Symposium on Plastics on April 17 for about 15 Architects, Designers and Teachers on the Council of Industrial Panel of Lecturers. In addition, Miss Sydney Foott, head of the C.o.I.D. Education Department and a few other members of the Council's staff also attended.

The Symposium, which included five talks and a film, was held at 12 Grosvenor Gardens by courtesy of Bakelite Ltd., who were the hosts for lunch.

Correction.—On page 104 of the March issue of *Plastics* we printed an equation for the toxicity quotient used in the British Plastics Federation Report No. 40. This equation should read $Q = \frac{E}{T} \times 1000$ and not as was printed in the March issue.

Literature

New British Standards.—Copies of these standards may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

Loaded and unloaded ebonite for electrical purposes (*B.S.* 234: 1957).—Improved testing techniques and a re-grouping of "Types" are the main features in this revision of the standard for ebonite which was first published 15 years ago.

B.S. 234 deals with ebonite in the form of sheets, rods, tubes and mouldings suitable for electrical purposes and composed substantially of good quality natural rubber and sulphur

with, or without the addition of suitable compounding ingredients.

The more significant alterations to the 1942 edition are that the ebonite is now classified in three types grouped according to their chemical loading.

Aminoplastic mouldings (*B.S.* 2906: 1957) and *Phenolic mouldings* (*B.S.* 2907: 1957).—Mouldings and moulding materials for aminoplastics and phenolics were formerly dealt with in British Standards 771 and 1322. The revisions of these standards dealt only with moulding *materials;* hence the need for the two new complementary standards for *mouldings* whose publication is now announced.

Methods of testing plastics part 3. "*Mechanical properties*" (*B.S.* 2782: 1957).—This is the latest addition to the series of standards dealing with methods of test used in the plastics industry. The publication provides details of test specimens apparatus, procedure and calculation of results for determining the mechanical properties of plastics.

Company News

K.W. Chemicals Ltd., 41 Kingsway, London, W.C.2, have been appointed U.K. selling representatives for the Mapre extruder equipment.

Monsanto Chemicals Limited and R. H. Cole & Co., Ltd., announce that they have come to an agreement under which Monsanto acquire, as an investment, 50% of the ordinary share capital of R. H. Cole & Co., Ltd. R. H. Cole & Co., Ltd., is a private company engaged in the marketing of raw materials and equipment to the plastics, chemical and electrical industries. It will remain as a separate entity under its own board of directors, with Mr. R. Hugh Cole and Mr. Peter H. Cole continuing as joint managing directors.

Cawley Plastics Ltd. are pleased to announce that in order to meet the ever-increasing number of telephone calls, an additional telephone line with the number Weybridge 4544 is now operating as well as the previous number Weybridge 4543.

Research & Control Instruments Ltd., Instrument House, 207 King's Cross Road, London, W.C.1 (Telephone: Terminus 8444), will become the sole distributors in the United Kingdom for the electronic instruments and scientific equipment hitherto marketed by Philips Electrical Ltd. (Research and Control Instruments Division).

The new Company will assume full responsibility for the maintenance of existing Philips' equipment and its field staff will be supported from a new Service Department and Stores located at 49 Temperley Road, Balham, London, S.W.12 (Telephone: Battersea 9166 and 9197). It will, in addition, become the distributors in Great Britain for the industrial X-ray equipment manufactured by C. H. F. Müller A.G., Hamburg, and for Norelco (U.S.A.) X-ray Diffraction and Spectrographic equipment.

(Left) Mr. J. D. Winston who has been appointed Sales Manager for Rigidex polythene.

(Right) Mr. S. Hope, Sales Director of Commercial Plastics (Sales) Ltd., who is visiting the Far East.

Shaw Moisture Meters, 31 Market Street, Bradford, Yorkshire, have been appointed as sole British agents for K. P. Mundinger, Germany's leading moisture meter manufacturers.

BX Plastics Limited announce that they are extending the manufacture of expandable polystyrene at their Branham Works. This material will be marketed solely by British Resin Products Limited, Devonshire House, Piccadilly, W.1, under the registered trade mark "Distrene," and Expanded Plastics Limited, Mitcham Road, Croydon (a subsidiary of Expanded Rubber Company Limited) under the trade name "Polyzote."

Erinoid Limited.—Consequent upon the Company becoming a subsidiary of O. & M. Kleemann Limited, its accounts will be made up to the Saturday nearest December 31 in each year.

At a Board Meeting held on April 3, it was decided that no dividend be paid on the £407,500 Ordinary Stock in respect of the five months ended December 28, 1957. The trading result of the five months shows a profit of £58,627. A stock depreciation figure of £113,894 has been included in the accounts.

O. & M. Kleemann Limited.—The Directors of O. & M. Kleemann Limited are recommending a final dividend making with the Interim Dividend of 12½% a total of 25%—for the year ended December 28, 1957.

The figure of profit of £218,308, which is subject to completion of audit, does not include the trading results of Erinoid Ltd.

Hercules Powder Company Limited.—As from May 5, 1958, the company will operate from One Great Cumberland Place, London, W.1. At the same time, the company's telephone number will become Ambassador 7766.

Personalities

Mr. Herbert Bridge has joined the board of Vent Axia Limited. Mr. Bridge also holds

The Micanite and Insulators Co., Ltd., stand at the recent A.S.E.E. Exhibition.

Mr. J. C. Swallow (right), chairman of I.C.I. Plastics Division, and Mr. E. Hunter, research director of I.C.I. Alkali Division, in front of the plaque in the research laboratories at Alkali Division, Winnington, commemorating the discovery of polythene 25 years ago.

This plaque was unveiled by Mr. J. C. Swallow who in 1933 was in charge of the research work at Alkali Division which led to the discovery of polythene.

The initials which appear on the plaque are those of R. O. Gibson and E. W. Fawcett, the two chemists engaged on the early experiment which produced a very small quantity of a solid polymer of ethylene on March 27, 1933.

directorships in the National Plastics Group and Record Pressers Ltd.

Mr. Robert Carr, Member of Parliament for Mitcham, has accepted the unanimous invitation of the Board of Directors of John Dale Limited to become Chairman of the Parent Company of their Group. As has already been announced Mr. Carr has relinquished his appointment as Parliamentary Secretary to the Ministry of Labour and National Service.

Mr. R. H. Cooke has been appointed a Director and General Manager of Research and Control Instruments Ltd.

Mr. W. J. Appleby.—Sheridan Croxted Limited announce the retirement of their Sales Manager—Mr. W. J. Appleby—on May 31, 1958. Mr. Appleby will remain available as a Consultant of the Company.

Mr. Roger G. Gibbins has been appointed Sales Manager, and **Miss Fay Barratt** Commercial Manager of Spesco Developments Ltd.

Mr. E. M. Fraser, C.B.E., Sales Controller of Imperial Chemical Industries Ltd., retired on March 31, 1958, after over 38 years' service with the Company and its predecessors. **Mr. J. H. Townsend,** at present Deputy Sales Controller of I.C.I., will succeed Mr. Fraser as Sales Controller.

Dr. M. A. T. Rogers has been appointed Research Controller of Imperial Chemical Industries Ltd., with effect from April 1, 1958. He succeeds Mr. R. M. Winter who is retiring from the Company after 30 years' service.

Mr. Charles H. Austin has been appointed a Director of Spicers Limited.

Mr. C. H. Flurscheim, Chief Electrical Engineer of Metropolitan-Vickers Electrical Co., Ltd., has been appointed a Director of the Company from April 1, 1958.

Mr. William Riley.—It is with regret we hear of the sudden death of Mr. William Riley, who since the war had been north-eastern area technical representative for Birkbys Ltd.

British Resin Products Ltd.—The following staff changes are announced by British Resin Products Limited:— **Mr. P. C. E. Kirby** has been appointed Export Manager to succeed Mr. H. E. Mabey who retired on March 31, after 21 years with the company. **Mr. C. D. Harvey-Piper** has been transferred from Overseas Sales and is appointed Assistant Sales Manager, Moulding Materials, with effect from May 1, 1958, covering Cellomold, Rockite and Styron. **Mr. J. E. Richardson,** formerly of B.I.P. Chemicals Limited, has joined the Overseas sales staff of British Resin Products Limited.

Mr. R. T. Conlon has been appointed Sales Manager of Insulators Limited of Edmonton, and took up his duties in April. From 1952 to 1957, he was Sales Manager of the Bowthorpe Holdings Group of Companies at Crawley, Sussex, one of which is Hellermann Ltd.

Glass Fabric Heating Element

GLASS is most familiar to the plastics industry as a reinforcing material for such resins as polyester, epoxy and phenolic. It may, however, become familiar in the near future as a heating medium as a result of the development work carried out by the Hunting Group of companies which has resulted in the manufacture of Mhoglas and the formation of Hunting Mhoglas Ltd., of Luton Airport, Beds.

Mhoglas is basically a glass fabric upon the fibres of which is deposited a coat of pure graphite. The graphite is sealed and protected by coating it with a thermosetting resin which is selected to suit the use to which the element is to be put. Epoxy resins are found to be the most satisfactory for this job under a wide variety of conditions. Mhoglas was originally developed as an element for heating surface areas evenly from comparatively low temperatures up to approximately 200° C. using a potential of from 2 to 3 volts up to 250 volts.

Variations in resistance, which is expressed in ohms per unit square, is attained by varying the number of coatings of graphite on the glass fabric, but the overall thickness of the deposit, even for resistances as low as 7 ohms per square, is of microdimensions. Normally, elements are made in resistances of from 6 to 100 ohms per square, but in special cases these limits can be exceeded, although in practice most requirements for elements can be met from standard resistances by variations in contacting, which is achieved by means of sprayed metal.

In this way, by series or parallel contacting, very high or low resistances can be obtained, as well as three-phase connecting, and sprayed circuiting.

The resin coating is the limiting factor as regards the temperature at which the element may be run, but the resin decomposition temperature may be greatly exceeded for runs of an intermittent nature.

Although the resin coating does unfortunately restrict the maximum working temperature of Mhoglas elements, a problem which is being tackled now, it undoubtedly endows them with many advantages, notably the ease with which the element may be used in potting techniques and laminating processes and subsequently cured with or without pressure, by hot or cold methods, making no difference to the original resistance of the element.

Furthermore, the element has a negative temperature coefficient of resistivity characteristic of carbon or graphite and this causes a lowering of resistance with increase of heat, as distinct from the opposite effect with metals, but even this may be regarded as an asset rather than a drawback as it follows that in an element designed to work at 150° C., at which temperature approximately 20% lowering of resistance would occur, an overload of the same order would not add to the strain, although the voltage would have to be lowered as soon as the temperature reached the maximum.

In this way Mhoglas elements may be designed with a "quick heat up" using a thermostat to control the temperature. This negative temperature coefficient is advantageous as the peak current does not occur on switch-on as in the case of metals but only when full load is on. Thus the thermal shock effect is reduced and intermittent switching test may be omitted as superfluous on the test bench.

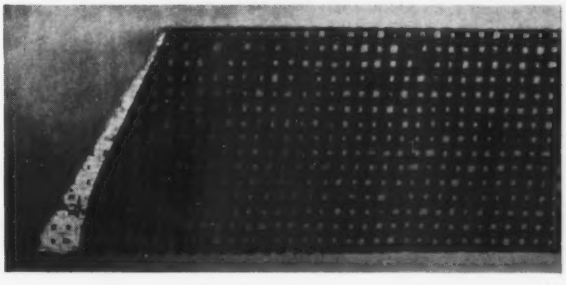
Mhoglas is made in continuous lengths, at present 1 ft. wide, but is usually supplied in 3 ft. to 4 ft. lengths, or preferably as completed elements with sprayed metal contacts. During fabrication it may be curved down to radii of 1 in., but during manufacture down to ¼ in. radius.

Applications

The Mhoglas element has for several years been used with success in combating the icing and low temperature problems associated with aircraft, and components operating at high altitudes and on this knowledge it is now offered for more general applications. Several domestic uses are visualized for it in conjunction with plastics materials. These include heater panels where the element is laminated between two plastic sheets. Bearing in mind the even heating of the element it can be seen that the whole plastic sheet can be brought up to a temperature below its softening point without hot spots occurring adjacent to the element as would be the case with metallic resistances. This being so the range of space heating applications incorporating plastics such as skirting boards, floors, etc., is enormous.

In industry too there are many interesting possibilities. As mentioned previously Mhoglas can be potted so its inclusion in an epoxy mould is a simple matter. By placing this element beneath the gel coat excellent heat transfer to all sections of the mould at an even temperature over all the surface area is obtained. Prototype and experimental work is being carried out by Thermo-Plastics Ltd. on the incorporation of a Mhoglas element in a glass fibre/polyester laminate and initial reports indicate that it is successful.

These are a few of the possible applications which Hunting Mhoglas Ltd. have already proved to be practicable and from these it can be seen that plastics will play an important part in the development of this new element for the domestic and industrial markets. It may also prove to be of benefit to the plastics industry itself in fabricating and indeed in moulding. Its development will be worth watching.



A piece of Mhoglas showing the sprayed metal contact and open structure of the fabric.

Equivalent Effects of Time and Temperature in the Deformation of Elastomers

By A. R. PAYNE, B.Sc., A.P.I.*

IT has long been known in a general way that the mechanical behaviour of rubbers is affected in a similar manner by either lowering the temperature or increasing the deformation rate; in either case the rubber becomes less easily deformable. Conversely, raising the temperature has a similar effect to reducing the deformation rate. Both these effects—of temperature and of deformation rate or frequency, are important technically, owing to the increasing use of rubber under extreme service conditions, and it is important that short-term experiments be evolved for the prediction of the long-term behaviour of rubber vulcanisates. The example described below is based on published data on the shear creep and recovery of elastomers, and shows that the percentage creep or recovery of a rubber measured over a short time interval, but at various temperatures, belongs to a generalized recovery/log time curve. It further shows how the temperature/time behaviour for rubber vulcanisates, including those containing fillers, can be described by a simple function. Indices of the low-temperature serviceability of rubber, and the prediction of their long-term behaviour are derived from this temperature/time equivalence.

1. Time and Temperature Effects in Creep

The dependence of creep phenomena on temperature in high polymers is well known, having been observed and discussed by a number of investigators (Leaderman, 1943), and it has been noted that for a given time interval the visco-elastic strain (or recovery) tends generally to increase with increase in temperature. Conant *et al.* showed that for rubber-like materials a consistent elevation of the strain/time curves with an increase of temperature is obtained, if corrections are made for the temperature fall which normally occurs when rubber is stretched, i.e. the well-known Gough-Joule effect (Conant *et al.*, 1949).

The observed dependence of the visco-elastic behaviour on temperature, implies that it should be experimentally possible to duplicate the strain S attained in time t_1 at a temperature T_1, with an equal strain S attained in time t_2 at temperature T_2. As has been indicated by a series of creep or recovery curves for a given material, each covering the same time interval but at different temperatures (T), the curves will be higher in the S direction with increasing values of T. These considerations show the possibility of selecting a series of temperatures such that each t/s curve at its end will match the beginning of the curve obtained at a higher temperature. Each end point will be at the particular value of S given by the combination of t_1 and T_1, which can be duplicated by another combination t_2 and T_2. Plotted on a log t abscissa scale and with a suitable abscissa shift, the curves will become segments of one generalized curve of S versus log t. It is not necessary to determine t_1 and t_2 to give identical values of S (this could be obtained only by a fortuitous choice of temperatures) in order to secure a smooth generalized curve, since when a series of curve segments obtained at reasonably well separated temperatures and overlapping on the S scale are available, a general continuous curve can be derived, and this has been done with the data of Conant *et al.*

The data were obtained from experiments which consisted in applying a shear stress to a " double sandwich " specimen, and observing the deformation as test conditions were varied. In the creep tests the specimens were first brought to thermal equilibrium at the desired temperature, then the shear stress of 35.6 p.s.i. was applied quickly and the consequent deformation noted at intervals of 5 seconds to 30 minutes after loading. In the recovery tests the specimen was conditioned overnight under load, the temperature was then gradually lowered to the lowest test temperature, the load was removed and the recovery noted at intervals of 5 seconds to 30 minutes. At the end of this time the load was reapplied and the temperature raised to the next test temperature.

In order to allow for the density and temperature changes due to the Gough-Joule effect, each result at a given temperature is expressed as a percentage of either the equilibrium deformation or of the complete recovery at that temperature. When expressed in this way the creep and recovery results were found equivalent within experimental error, and only the recovery data are quoted below, although the conclusions reached apply to both.

2. Joining of the Recovery Curves Obtained at Different Temperatures

Fig. 1 shows the continuous curve derived by combining curve segments for different temperatures. The curve segments are 30-minutes recovery data for Conant's natural rubber stock B.; the percentage recovery is plotted against the equivalent time and it is seen that a very smooth continuous curve results. Figs. 2, 3 and 4 are similar to Fig. 1 but refer to GR-S, neoprene and butadiene-acrylonitrile copolymer (Butaprene).

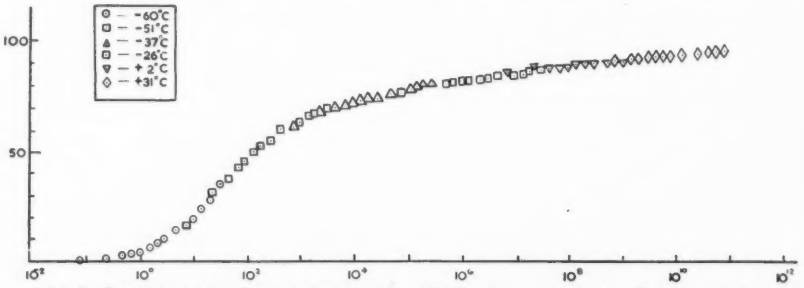


Fig. 1. Equivalent time from beginning of —60° C. recovery (mins.). Recovery from equilibrium deformation. Natural rubber. 35.6 lb./sq. in. load.

If the same recovery value is reached after time t_1 at temperature T_1 and after time t_2 at temperature T_2, the T_2 curve must be shifted a distance (log t_1 — log t_2) along the abscissa to make it continuous with the T_1 curve; for convenience we can write:

$$\Delta \log t = (\log t_1 - \log t_2) \quad \ldots\ldots(1)$$

$$\Delta \quad T = (T_1 - T_2) \quad \ldots\ldots\ldots\ldots(2)$$

It is then found that plotting $\Delta \log t$ against ΔT gives a characteristic curve resembling the $\Delta \log \omega / \Delta T$ curves obtained from oscillatory mechanical and dielectric measurements. These curves, first investigated by Williams (1955), have been shown to apply to cross-linked

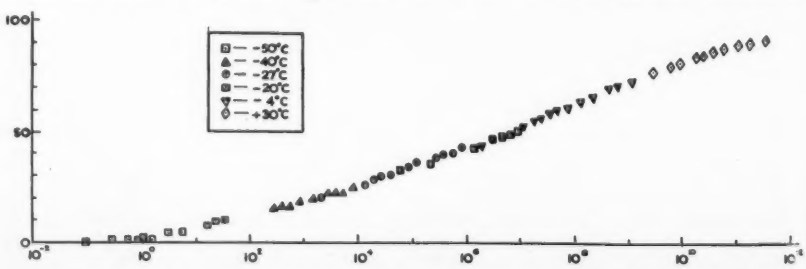


Fig. 2. Equivalent time from beginning of —50° C. recovery (mins.). GR-S. 35.6 lb./sq. in. load.

* Research Association of British Rubber Manufacturers, Shawbury.

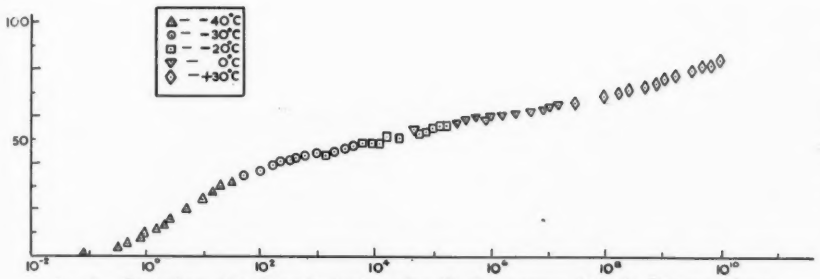


Fig. 3. Equivalent time from beginning of —40° C. recovery (mins.). Recovery from equilibrium deformation. Neoprene G.N. 35.6 lb./sq. in. load.

polymers by the present author (Payne, 1957; Norman and Payne, 1958).

In an amorphous polymer above its glass transition temperature, the ratio of any mechanical retardation time at any temperature T to its value at a reference temperature T_s (derived from transient or oscillatory visco-elastic measurements or from steady flow viscosity), appears to be identical over the complete relaxation spectrum. We can thus write:

$$a_T = \frac{\text{retardation time at } T}{\text{retardation time at } T_s} \quad \ldots\ldots(3)$$

Moreover, the relationship between the ratio a_T and the temperature difference $(T - T_s)$ appears to have a universal significance, if T_s is a separate reference temperature for each polymer, related to the glass transition temperature (Williams *et al.*, 1955). The curve in Fig. 5 shows the relation between this ratio and the temperature difference $(T - T_s)$ as obtained from mechanical and electrical data.

Using equation 3 it can be shown that

$$\Delta \log t = \log a_T + \text{constant} \quad \ldots\ldots(4)$$

$$\Delta T = (T - T_s) + \text{constant} \quad \ldots\ldots(5)$$

Hence the $\Delta \log t / \Delta T$ curve obtained experimentally from t_1, t_2, T_1 and T_2 (equations (1) and (2)) should have the same shape as the curve of $\log a_T$ against $(T - T_s)$, so that it should be possible to make the two curves coincide by suitable horizontal and vertical displacements. This is confirmed by Fig. 5, in which the points, from the $\Delta \log t / \Delta T$ graphs derived from the data of Figs. 1, 2, 3 and 4, are seen to fit closely on the curve representing the generalized relationship between $\log a_T$ and $(T - T_s)$.

The empirical equation describing the curve in Fig. 5 is given by Williams *et al.* (1955) as:

$$\log a_T = -8.86\,(T - T_s)/(101.6 + T - T_s) \quad \ldots\ldots(6)$$

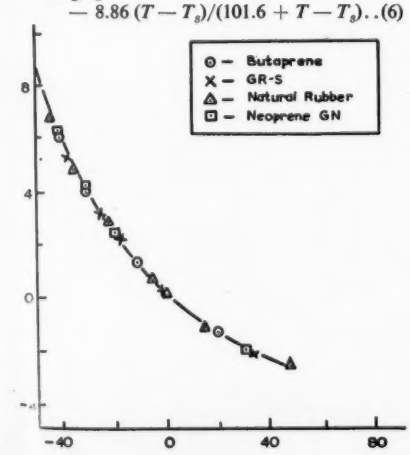


Fig. 5.

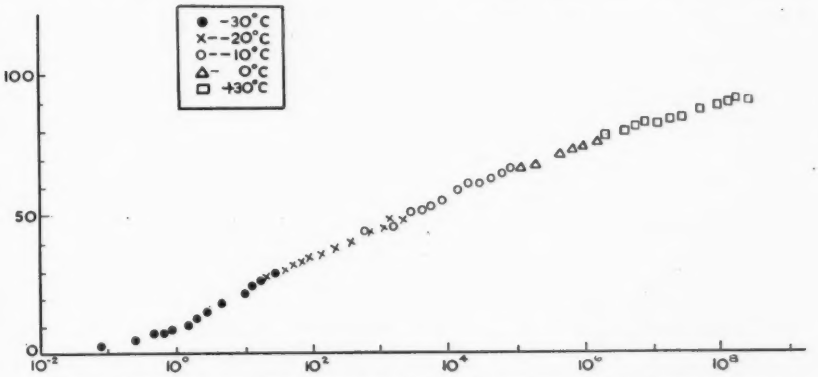


Fig. 4. Equivalent time from beginning of —30° C. recovery (mins.). Recovery from equilibrium deformation. Butaprene. 35.6 lb./sq. in. load.

from which, by equations (1) and (2):

$$\Delta \log t = -8.86\,(T_1 - T_s)/(101.6 + T_1 - T_s) + 8.86\,(T_2 - T_s)/(101.6 + T_2 - T_s) \quad \ldots\ldots(7)$$

and $$\Delta T = (T_1 - T_s) + (T_s - T_2) \quad \ldots\ldots(8)$$

The T_s values which give the best fit of the data to equations (6), (7) and (8), for the materials studied are given in Table 1 below:

TABLE 1.

Material	T_s Value
Hevea (Natural Rubber)	256°K
GR-S	275°K
Neoprene GN	272°K
Butaprene	282°K

The above paragraphs may be held to prove, albeit indirectly, that time and temperature changes are equivalent, and it is instructive to demonstrate more directly that this approach is valid, although the data from which this can be done are more limited, and refer to a single temperature. Conant *et al.* (1950) gave data showing the recovery over 16 hours of a sample of Hevea rubber at — 60° C. These are shown as the points in Fig. 6. The full line in this figure is the generalized recovery curve from Fig. 1; there is good agreement between the two types of measurement.

3. Low-Temperature Testing and Serviceability

The interdependence of time, temperature, stress and strain in visco-elastic phenomena is well known, and Mullins (1945), who recognized the need for a test for low-temperature serviceability, with time as a parameter, stated the need for a simple expression relating modulus with time. Many of the low-temperature tests, such as Gehman's torsion test (Gehman *et al.*, 1947), the Young's modulus test of Conant *et al.* (1944), and the cold compression-set test (Morris *et al.*, 1945) recognize time only to the extent that they specify a particular stressing or straining time in making the measurement. The T.50 test (McCortney *et al.*, 1941), is arbitrary in that both time and temperature are varied simultaneously. The tentative test discussed below takes account of both time and temperature.

What has been accomplished above is the synthesis of a percentage recovery (or creep) curve over an extended time at a definite temperature but valid for any temperature by appropriate choice of the time (or more precisely log t) scale. There are two ways of using this curve and these are considered on the following page.

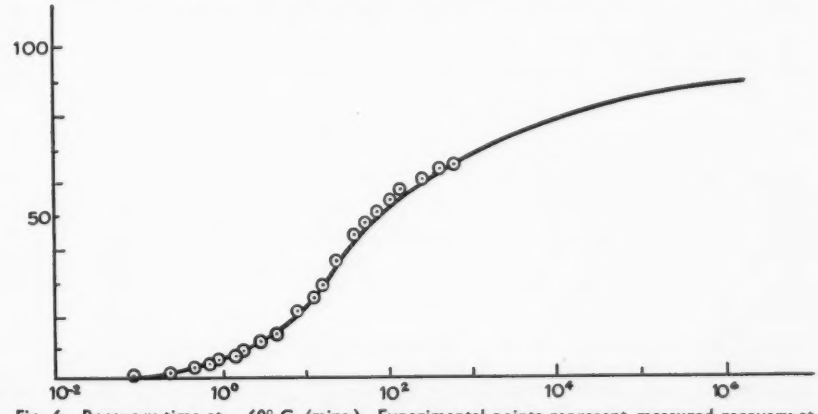


Fig. 6. Recovery time at —60° C. (mins.). Experimental points represent measured recovery at —60° C. Curve obtained by piecing together recoveries at —60° C., —57° C., —37° C., —26° C., +2° C., and +30° C.

3.1. To Deduce the Lowest Temperature for a Given Recovery in a Given Time

Given the minimum recovery required for a particular application, the lowest temperature which would allow this recovery within a definite time interval is easily obtained. For instance, if an experiment can be carried out at several temperatures over a time range of, say, 1 second to 20 minutes, then the lowest temperature at which a rubber will recover 50% in 10 minutes can be interpolated from a series of time-recovery graphs at different temperatures and used as an index of low-temperature serviceability.

The precise recovery and time chosen as the criterion would suit the mechanical requirements desired for the rubber; and the time interval could lie outside the time range actually used in the experiments.

3.3. To Deduce the Time Required For a Given Recovery at a Given Temperature

In the second use of this method, the overall curve for a particular temperature, which could be the lowest temperature that would be required in service, would be obtained, and hence the time to recover a given amount determined.

This time could then be the index of serviceability and could be compared with the times obtained from similar overall curves for other rubbers for the same temperature. The first use thus provides a temperature index and the second a time index.

4. Creep Behaviour At Long Time Intervals

It is seen that from the overall curves the percentage creep or percentage recovery at very long times can be predicted, and it is the creep behaviour especially that is of interest in such applications as rubber engine-mountings, since it influences the space relationships between various parts of the equipment. However, even with this technique of the temperature/time equivalence, it might still be difficult to predict creep for a given application because several factors have an important effect upon this property. Chief amongst these are the amount of strain, the temperature, and the changes in these two resulting from vibration. The temperature variations could be allowed for by superimposing the overall curves for the different temperatures at the strain at which the temperature change occurs.

5. Conclusions

From other work on the dielectric and mechanical properties of rubbers, involving other types of deformation besides creep and recovery it has been shown that the T_s values obtained on a particular polymer are the same from either the dielectric or the many possible types of mechanical measurement (Williams *et al.*, 1955; Payne, 1957*b*). Furthermore for the majority of the types of rubber compound used for rubber engineering, $T_s = T_g + 50°$ C. (Williams *et al.*, 1955), where T_g is the second-order glass transition temperature. Thus if the T_g value is known, then the temperature/frequency (time) relationship of the polymer is defined, and the overall curves may then be obtained from limited data. Alternatively the T_s value can be obtained from curve-fitting of the experimental results, $\Delta \log t$ and ΔT, with the empirical equation (6). The value of equation (6) has been demonstrated more rigorously than in this paper for the dynamic (mechanical) and dielectric measurements for a wide range of long-chained polymeric materials (Williams *et al.*, 1955; Payne, 1957), and indeed the equations seems to be of very wide application, and possibly of fundamental significance, although the means of determining the equivalence may seem to be rather empirical.

References

Conant, F. S., Hall, G. L., and Lyons, W. J. (1950), *J. Appl. Phys.*, **21,** 499.

Conant, F. S., Hall, G. L., and Thurman, G. R. (1949), *J. Appl. Phys.*, **20,** 526.

Gehman, S. D., Woodford, D. E., and Wilkinson, C. S. (1947), *Ind. Eng. Chem.*, **39,** 1108.

Leaderman, H. (1943), "Elastic and Creep Properties of Filamentous Materials and other High Polymers." Textile Foundation, Washington, 1943, pp. 30–33.

Mullins, L. (1945), *Trans. I.R.I.*, **21,** 247.

Morris, R. E., Hollister, J. W., and Mallard, P.A. (1945), *India Rubber World*, **112,** 455.

McCortney, W. S., and Hendrick, J. V. (1941), *Ind. Eng. Chem.*, **33,** 579.

Norman, R. H., and Payne, A. R. (1958), Paper to be submitted to the *Proceedings* of the Institution of Electrical Engineers.

Payne, A. R. (1957*a*), *J. Appl. Phys.*, **28,** 378.

Payne, A. R. (1957*b*), "The Rheology of Elastomers Conference Proceedings," British Society of Rheology. In the press.

Williams, M. L. (1955), *J. Phys. Chem.*, **59,** 95.

Williams, M. L., Landel, R. F., and Ferry, J. D. (1955), *J. Am. Chem. Soc.*, **77,** 3701.

Acknowledgement

The author wishes to thank the Council of the Research Association of British Rubber Manufacturers for permission to quote results from RABRM Research Memorandum No. R407.

Triulzi Model 30 Injection Press

IN June, 1957, we published in *Plastics* (pages 212 and 213) a description of the Triulzi moulding presses. A new model has now been added to their range of injection moulding machines known as the Model 30. This is a self-contained fast-cycling press of approximately 1 oz. shot capacity designed for automatic or semi-automatic operation.

The main frame of the Model 30 which is of welded construction houses the 4.5 h.p. electric motor, the hydraulic oil pump and the oil reservoir, together with the pipework valves and distributor for the hydraulic system. The oil reservoir is fitted with a cooling unit. The platens are supported by two tie bars fitted to a steel feed casting and tail casting. The tie bars are adjustable. The moving mould platen is operated by a hydraulic cylinder through a toggle system which has nitrided steel pins and bushes. Alteration to the mould thickness setting is made by adjusting the toggle mechanism by moving the position of the fulcrum on the machine bed. The semi-fixed injection platen provides the sprue-break movement by the action of springs. This movement is fully adjustable.

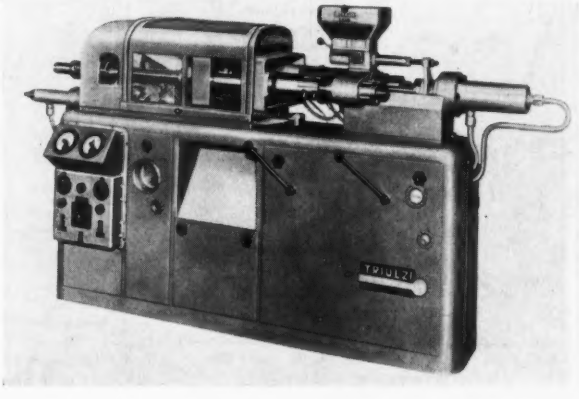
The injection cylinder is the Triulzi Type H, made of alloy steel internally hard chrome-plated as is the torpedo. Band heaters of 4.2 kW. capacity provide the heating element. The injection plunger which is water cooled is of nitrided steel and is operated by a hydraulic cylinder.

Controls

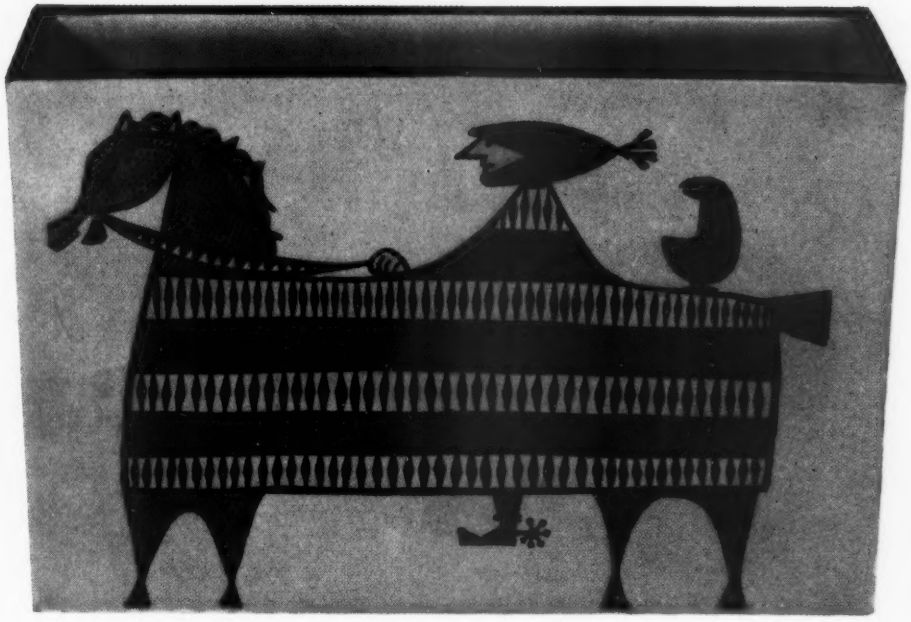
One of the features of this machine is the control and operating mechanism which provides infinite but simple adjustment to obtain maximum output at the highest quality. Both the injection and clamping speeds are adjustable by means of valves and cushioning valves are fitted to give a slow approach speed to prevent mould slam. A similar valve is fitted to avoid damage to the moulding on ejection which is by mechanical means.

A safety guard is fitted which prevents the machine operating when the guard is open. Closing the gate closes the platens.

The electrical equipment includes electronic temperature controllers and for the machines fitted for automatic operation, timers, control switches and a photo electric cell unit initiates the cycle of operations when the moulding breaks the light beam.



The Triulzi Model 30 self-contained fast-cycling press.



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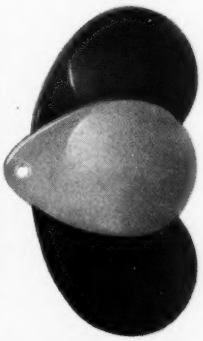
Stig Lindberg



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The Microstructure of Crazed Plastics

A report of recent work into the subject carried out by the United States National Bureau of Standards.

WHEN a transparent plastic material crazes, that is, forms minute cracks after being moulded or cast into shape, its optical and strength properties deteriorate. During the past several years research on multi-axial stretching has vastly improved the finished material; however, a tendency to craze is still encountered in plastic products ranging from aircraft canopies to watch crystals.

In an effort to ascertain the characteristics and mechanism of the crazing phenomenon, an optical study of plastics exposed to stress, or to stress and solvent combined, was undertaken at the U.S. National Bureau of Standards. Sponsored by the U.S. National Advisory Committee for Aeronautics, the work was conducted by Dr. Sanford B. Newman and Dr. Irvin Wolock of the Bureau's plastics laboratory. The experimental results may lead to the development of better materials, or to improved methods of handling those now available.

With the multiple-beam interference microscope the investigators found that *each surface crack in a crazed specimen is surrounded by a raised area which appears to increase with the size of the crack*. Interference fringes, from beams reflected by both the plastic and optical reference surfaces, were observed at the microscope eyepiece. When an undamaged plastic surface was used, the fringes were relatively parallel and showed no abrupt discontinuities. But after the plastic surface had been crazed, peaks appeared in the fringes, indicating abrupt surface discontinuities at each crack.

The parallel fringes mark changes of one-half the wavelength of light in the distance between the specimen and the optical reference surface. Thus the magnitude of any local deviation from flatness can be assessed by the displacement of the fringes appearing in the interferogram. The multiple-beam interference microscope yields large magnifications in the direction of height or depth.

Results of one experiment showed that a surface crazed by a solvent developed peaks which in some cases extended the total distance between adjacent fringes. Thus, the craze cracks in the field were surrounded by areas dislocated from the remainder of the field by up to 273 millimicrons, the distance between fringes. The effectiveness of treating plastics to eliminate defects can be calculated from these surface dislocations.

It has been shown in the past that when a crazed plastic object is heated at elevated temperatures, clarity is restored to the object. In the present investigation, specimens of polymethyl methacrylate were stress-solvent-crazed and then heated in an air-circulating oven for periods up to 15 hours. Upon examination with either the bright field microscope or the unaided eye, the heat-treated specimens appeared clear and uncrazed. However, multiple-beam interferometry of their surfaces revealed dislocations similar to those found on unheated stress-solvent-crazed specimens.

Sufficient flow had occurred in the heated specimens to close the cracks but not to eliminate the large mass of dislocated material around the crack. The sites of the original failures would, no doubt, produce cracks again when exposed to stress. From this it is obvious that treating stress-solvent-crazed structures with heat does not restore the material to its pristine state. Acrylic sheets crazed by stress alone appear to recover more completely; however, residual surface dislocations would be expected from the known rheological properties of the plastic.

Crazing with polymethyl methacrylate is a purely surface phenomenon; that is, all of the observed cracks intersect the surface plane. But both surface and internal cracks were observed in the other two plastics investigated, polystyrene and polymethyl alpha-chloroacrylate. Whether the distribution of craze cracks in these plastics is an intrinsic characteristic or is due to the level of refinement of the manufacturing process could not be ascertained. In the polystyrene specimens investigated, the internal cracks were usually associated with foreign particles or other inhomogeneities in the matrix.

Electron microscope used at the U.S. National Bureau of Standards to study the microstructure of plastics. The surface replica of a plastics specimen, mounted on a 200 wire mesh $\frac{1}{8}$ in. diameter, is being inserted into the microscope's column. When the replica is in place, its enlarged image may be viewed through the rectangular glass port at the front of the microscope.

Optical studies reveal another method of stress relaxation in plastic surfaces. When acrylic specimens break at strains of approximately 20%, they first craze and then develop a series of flow lines. As their name implies, flow lines are part of the unrecoverable stress response. The flow lines form an angle of from 35° to 45° with the long dimension of the craze cracks. Multiple-beam interference techniques indicate that the traces of these flow lines are superficial, not rising more than 25 to 50 millimicrons above the surface. In some acrylic specimens the flow lines were observed although the craze cracks had disappeared after a long recovery period.

Residual adhesive from the masking paper applied to protect the surface of plastic sheets may cause deterioration. Flow lines were found to radiate from nuclei consisting of droplets of adhesive after specimens had been subjected to high stresses. Furthermore, the craze cracks were found to gape more widely and to occur in larger numbers where traces of adhesive had remained on the surface. It is possible that the effect of the adhesive increases the longer it remains in contact with the material.

A limited number of electron microscope observations were made on surface replicas of crazed acrylic specimens. The replicas were prepared according to a method described by Zworykin and Ramberg. As electron microscopy limits the size of the specimen, only surfaces containing fine cracks were examined.

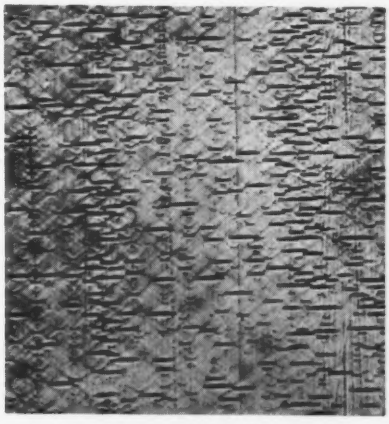
Dimensions of the finest cracks were measured with fair precision. Lengths varied from two to 10 microns; widths from 0.10 to 0.25 microns; depths from 0.05 to 0.15 microns. Because the dimensions of all observed cracks could be resolved in the electron microscope, it is concluded that plastics have a minimum craze-crack length. Possibly, a specific minimum amount of energy is required to separate the chain segments of a plastic material and, as such separation leads to crazing, the energy threshold results in a minimum crack size. Further investigations will be made to determine exactly the minimum crack size of different plastics under varying conditions.

References

Development of craze and impact resistance in glazing plastics by multiaxial stretching, by G. M. Kline, I. Wolock, B. M. Axilrod, M. A. Sherman, D. A. George, and V. Cohen, NACA Report 1290 (1956).

Optical studies of crazed plastic surfaces, by Sandford B. Newman and Irvin Wolock, *J. Research NBS*, **58**, 339 (1957) RP 2767.

Surface studies with the electron microscope, by V. K. Zworykin and E. G. Ramberg, *J. Appl. Phys.*, **12**, 692 (1941).



Surface of a stress-crazed tensile specimen of polymethyl methacrylate. The image has been slightly defocused to emphasize the flow lines at the ends of the cracks.

Plastics in the Laboratory—Part 3

By G. HAIM*

Continuing this series, the author discusses in this instalment containers for standard solutions, fans, filter papers, jugs, police rods, tubing, pumps, scoops, scrapers, sink traps and siphons.

Plastic Containers for Standard Solutions

A great many laboratories prefer to buy standardized solutions for volumetric work, to save time and supervision by senior analysts. These standard solutions are supplied in glass or polythene bottles, or they can be obtained in concentrated form in glass vials with a tapered top, which is pierced or cut off before the liquid is transferred to a volumetric flask and made up to the indicated amount with distilled water.

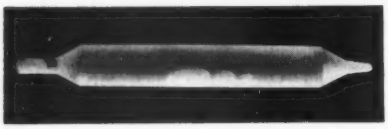


Fig. 22. Polythene container for standard solutions.

A typical vial made of polythene is shown in Fig. 22. At the present time this can be obtained only from Germany—under the trade name Fixanal—from Riedel de Haën, Hanover.

Plastic Fume Ducts

The use of plastic fume cupboards and plastic fans has been described elsewhere in this paper. Their use is closely connected with plastic fume ducts, as the corrosive fumes have to be carried away, and there is no point in employing corrosive - resisting materials for fume cupboards and fans if the fume duct itself is not equally resistant to corrosion.

Polythene and p.v.c. fume ducts of round or square cross section are being used on an increasing scale. They can be assembled from standard sections either by means of flanges or by belling one end of each section of the tubing so that it fits closely over the unbelled end of the next section. Fig. 23 shows a large polythene duct system installed in an industrial laboratory.

Plastic Fans

Relatively cheap fans moulded from phenolics have been available for many years. They need frequent replacement, and as replacements are seldom stocked on the premises, some time may elapse before the new fan is installed. This delay is liable to cause a great deal of damage to expensive equipment.

Steel fans coated with p.v.c., polythene or epoxy resins provide a compromise, but the most satisfactory type of fan is one fabricated entirely from p.v.c. or polythene. A whole range of p.v.c. fans is now available, catering for almost any requirements which may arise in chemical laboratories. Fig. 24 shows a p.v.c. fan with a capacity of 800 cu. ft. per minute.

Fans made from high molecular weight polythene are as suitable as p.v.c. fans, but they have not been on the market sufficiently long for a final opinion to be expressed.

* Rediweld Ltd.

Fig. 24. P.v.c. fan of 800 cu. ft. per minute capacity.

Plastic Filter "Papers"

There are many applications calling for the filtering of strongly acidic or alkaline solutions. Ordinary filter papers disintegrate quite quickly under these conditions, and the cone of the filter paper frequently tends to fall out, making the whole filtering operation useless. In such cases p.v.c. filter "paper" made from matted p.v.c. fibres which are afterwards sintered can be used with advantage. It should, however, be borne in mind that p.v.c. filter "paper" does not wet and does not necessarily filter in the same way as ordinary filter paper. It is available in circles of various diameters and in the form of sheets under the trade name Rhovyl.

Only one quality of plastic filter paper is produced at the present time, compared with a wide variety of ordinary filter papers. Rhovyl filter papers are not liable to attack by bacteria and can, therefore, be usefully employed in biological laboratories. The mechanical strength of Rhovyl filter papers in the wet state is almost as good as in its dry state (2,100–2,250 p.s.i.), permitting their use in laboratory filter presses. P.v.c. is attacked by organic solvents of all kinds, and these should not, therefore, be filtered through Rhovyl filters.

Rhovyl filter paper is available in circles from 2.7 cm. to 24 cm. in diameter, in sheets 20 cm. × 20 cm., 40 cm. × 40 cm., 60 cm. × 60 cm., and in rolls 91 cm. wide.

American trade journals have recently published reports of the pilot plant production of other types of plastic filter "papers" from nylon and Terylene fibres.

Plastic Jugs

Plastic jugs of 2- and 4-pint capacity with an engraved scale are useful for the transfer of acids and alkalis from carboys to bottles or small tanks. The polythene jug shown in Fig. 25 is supplied with an engraved measuring stick marked in fluid ounces or millilitres. P.v.c. jugs are less popular than polythene jugs on account of the higher price and greater risk of breaking.

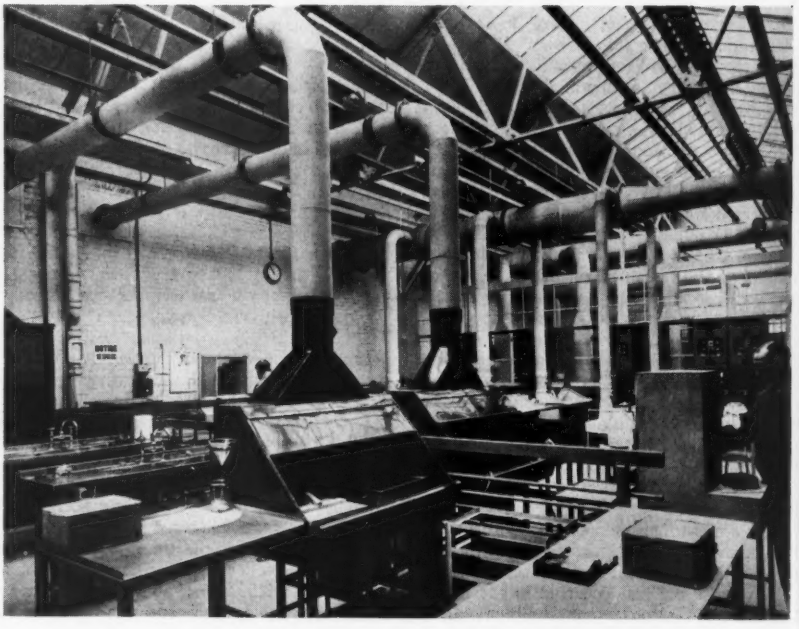


Fig. 23. Large polythene duct system installed in an industrial laboratory.

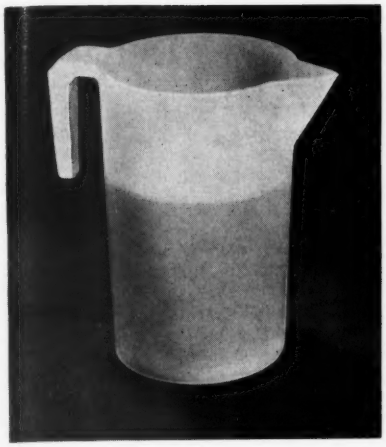


Fig. 25. Polythene jugs.

Police Rods

Polythene police rods or stirring rods have a limited use. They are not easy to clean and are not recommended for quantitative work, except in cases where hydrofluoric acid is used, ruling out glass rods.

Plastic Tubing

Polythene, and plasticized and rigid polyvinyl chloride have many advantages over glass and rubber for tubing.

As far as polythene tubing is concerned, it can frequently be used for pipe and drainage lines, as it is not attacked by most of the chemicals encountered in a laboratory. Solvents passing into the drain in small quantities and diluted with water will not harm the tubing.

Rigid p.v.c. tubing is used on a comparatively small scale in laboratories, mainly for drainage purposes. Fig. 26 shows a drainage system in a laboratory bench built up from standard sections.

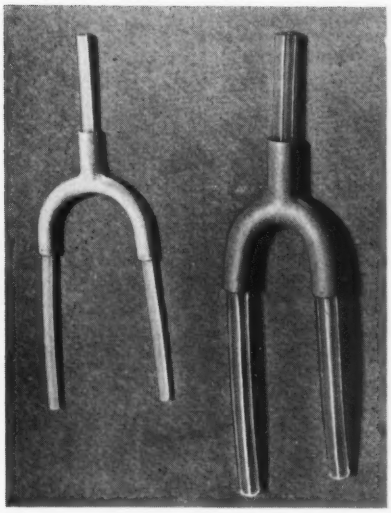


Fig. 27. Saddle type fittings for connecting plasticized p.v.c. tubing.

Glass-clear plasticized p.v.c. tubing can be employed for condensers and the like, whilst coloured plasticized p.v.c. tubing is used in many instances instead of rubber, as it does not perish as quickly as rubber when in contact with oxidizing agents, neither does it get brittle due to oxidization when stored.

Polythene and rigid p.v.c. pipes are connected up by means of flanges or bell and spigot fittings, whilst special saddle type fittings (Fig. 27) are recommended for plasticized p.v.c. tubing. Polythene connectors (Fig. 28) are also used for connecting up p.v.c. tubing.

Pumps

To describe the great many types of pump used in the laboratory would be beyond the scope of this paper, and mention will be made only of the more useful types.

Fig. 29 shows a hand-operated piston pump

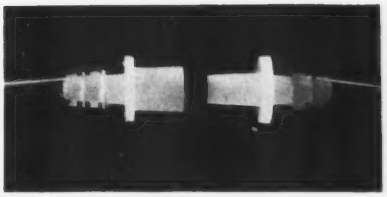


Fig. 28. Polythene connectors for p.v.c. tubing.

suitable for the discharge of acids and corrosive solutions from carboys. These work only intermittently and have a somewhat limited output, as they quickly tire the operator.

Fig. 30 shows a diaphragm pump for emptying carboys or tanks. Liquids with a specific gravity of approximately 1.0 are lifted to a 10 ft. head, and heavier liquids proportionately less. The action is continuous, and the capacity would be approximately 300

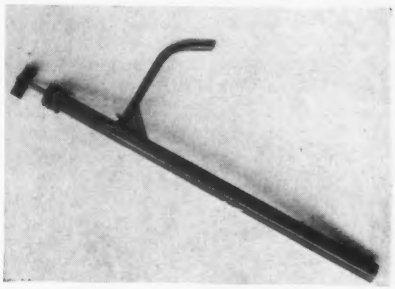


Fig. 29. Hand-operated piston pump.

gallons per hour with uninterrupted operation. The diaphragm consists of a layer of thin polythene foils. Special diaphragms made of plasticized p.v.c., sulphonated polythene (Hypalon), p.t.f.e. and the like can also be supplied.

The centrifugal pump illustrated in Fig. 31 consists of two moulded polythene parts (rotor and housing). The rotor is mounted on a

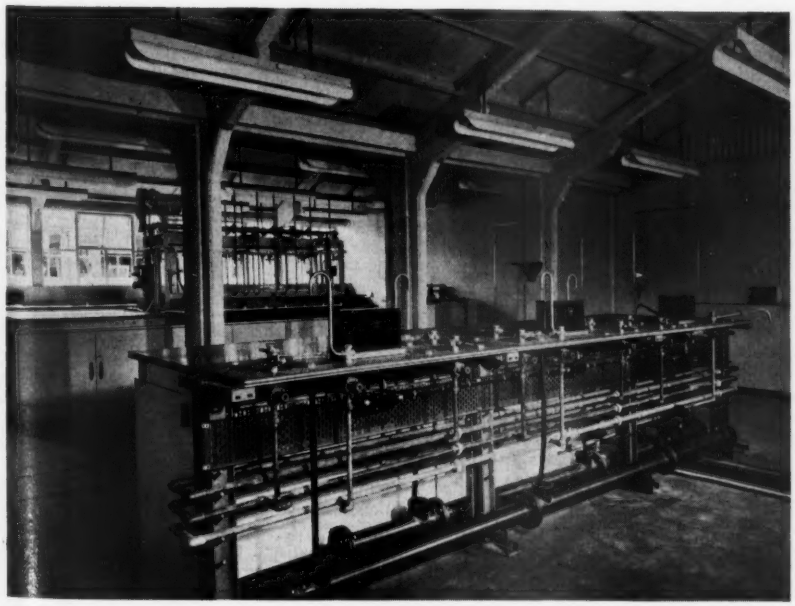


Fig. 26. P.v.c. drainage system in a modern laboratory. (Courtesy I.C.I. Plastics Division.)

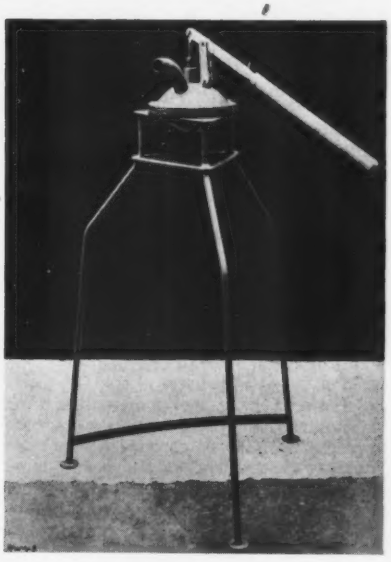


Fig. 30. Diaphragm pump.

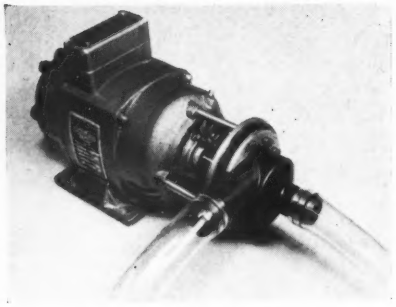


Fig. 31. Centrifugal pump.

titanium spindle. Where titanium would not be satisfactory, other types of spindles are available, made of Inconel, Monel, stainless steel, etc.

Fig. 32 shows a hand-operated barrel pump with positive displacement. Its action is very similar to that of pumps found in oil stores and garages.

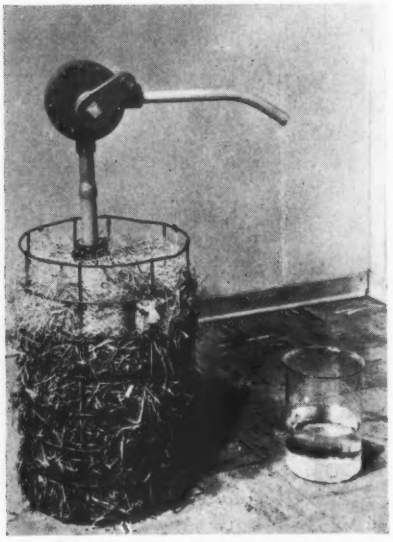


Fig. 32. Hand-operated barrel pump.

Scoops

Injection-moulded plastic scoops are obtainable in most hardware stores, multiple stores and the like. They are comparatively small in size and are suitable only for household purposes. Polythene scoops are mostly fabricated and can be made in any convenient size. They are useful for handling corrosive powders but less suitable for abrasive powders, which damage the surface of the polythene. P.v.c. scoops are a slight improvement in this respect; they are moulded from sheet stock in a variety of colours and sizes.

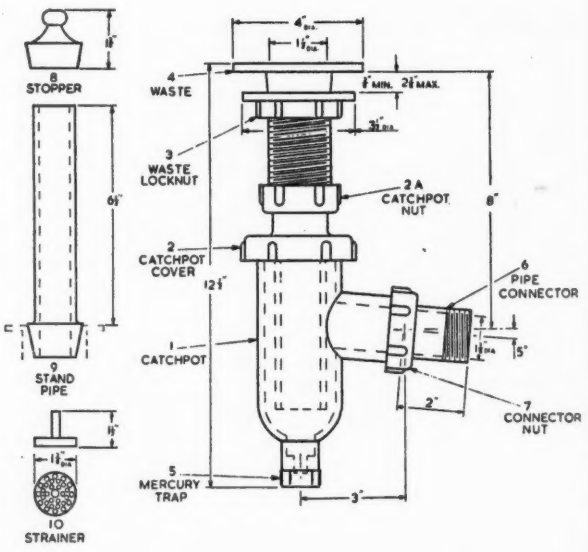
Scrapers

Polystyrene, p.v.c. and polythene scrapers have the advantage that they do not scratch the surface of glass or porcelain to the same extent as metal scrapers. They are not produced as a standard item and are, therefore, rather expensive.

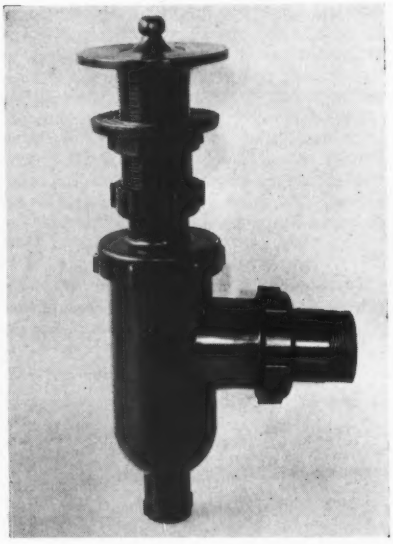
Sink Traps

Ebonite sink traps disintegrate fast when in contact with strong acids, especially nitric acid; lead sink traps perish very quickly when in contact with mercury. Fig. 33 shows a moulded polythene sink trap with an incorporated mercury trap, and Fig. 34 gives details of the component parts. Polythene sink traps do not have the same disadvantages as ebonite and lead and may soon replace them entirely for work in laboratories. Further advantages of polythene sink traps are that they are light in weight (12 to 14 oz.), easy to clean and easy to install.

(Right) Fig. 34. Component parts of a polythene sink trap.



(Below) Fig. 33. Moulded polythene sink trap.



Siphons

Many different devices are used to empty carboys containing distilled water, acids and other types of solution. The majority, however, are not too satisfactory: they leak after a comparatively short time, and acids accidentally spilt may damage the floor or laboratory furniture and also clothing.

Plastic siphons and emptying devices are definitely to be preferred. Two of the more popular siphons—one in polythene and one in p.v.c.—are shown in Figs. 35 and 36.

The polythene siphon can be inserted into the neck of the carboy without the aid of a stopper. A vacuum is created by pressing the polythene suction chamber. When pressure on this suction chamber is relaxed, the liquid siphons over and is kept in the reservoir until the closure at the lower end is operated. The reservoir should hold enough liquid to allow repeat operations.

The p.v.c. siphon works on a slightly different principle and requires a stopper, which is preferably made of plasticized p.v.c. Neither the rubber bulb nor the p.v.c. stopper is in direct contact with the liquid to be transferred. The operation of this siphon is quite simple. The pressure is built up inside the carboy by repeated operation of the rubber bulb, until the liquid flows over. When the required amount of liquid has been transferred, pressure on the small knob on the side of the emptying device reduces pressure inside the carboy, and the liquid transfer stops at once. When properly operated, this device permits the transfer of strictly limited quantities without spillage or overdosing.

Fig. 35. Polythene siphon.

Fig. 36. P.v.c. siphon.

(*To be continued*)

Catalyst Structure and Polymer Properties in Polyethylene Type Polymers

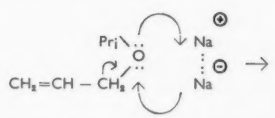
By E. G. CURPHEY

ORGANO metallic catalyst compositions find important applications in modern polymerization techniques for polyethylene. Such species of catalyst are not, however, new and around 1938 binary mixtures of aluminium triethylate and aluminium trichloride featured in the polymerization of ethylene. Another catalyst mixture used was titanium tetrabromide and ethyl metatitanate which appeared about the same time. Between 1938 and 1942 little development took place in this field. After 1942 the lithium alkyls were introduced in solution polymerization techniques for polyethylene. In 1950 Ziegler obtained high molecular weight α-olefines by the alkylation of appropriate aluminium trialkyls. The intermediate complex trialkyls disproportionated at the higher temperatures, affording the corresponding olefines.

$$Al\,Me_3 + 3nC_2H_4 \longrightarrow Al\,[CH_2.(CH_2)_{n-1}.CH_2]_3$$

$$Al\,[CH_2.(CH_2)_{n-1}.CH_2]_3 \longrightarrow Al\,H_3 + 3\,CH_2.(CH_2)_{n-2}CH=CH_2$$

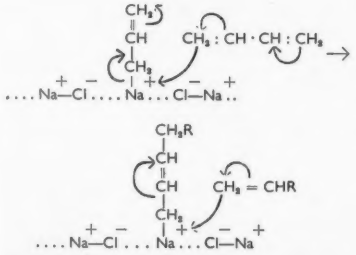
A few years later the Alfin catalysts appeared. These had originally emerged from the cleavage of an alkenyl ether with sodium.



$$Pr^i\,O\,Na + CH_2 = CH\,.\,CH_2\,Na$$

The ultimate Alfin catalyst, however, comprised a mixture of sodium alkenyl, sodium isopropoxide and common salt. The latter was essential for the success of the catalyst. It had been introduced as an accident, mainly as the result of impurities arising from the Wurtz's synthesis of the ether.

The mechanism of the Alfin polymerization has never been lucidly interpreted. A mechanism might be postulated, however, based on the electromeric changes associated with the chemical components of the catalyst. This mechanism is shown below. (See note 1.) For the sake of simplicity the isopropoxide contribution has not been included.



Polyethylene analogues have been obtained using less conventional reactions. The polynitroethylenes, for example, have been obtained by the action of alcohol on 1 : 2-di-nitroethane, the latter having been obtained by the addition of nitrogen tetroxide on ethylene at very low temperatures.

Aluminium Trialkyl as Reducing Agent

In the presence of suitable salts the aluminium trialkyls function as reducing agents. Thus aluminium trialkyl reduces nickel salts to free nickel. Based on this observation, Ziegler demonstrated that below 120° C. a binary mixture of colloidal nickel dimerized ethylene almost quantitatively to but-1-ene. These observations implied that modifications in catalyst structure were paramount to all other conditions for exerting an influence on the structure of the emergent polymer. Shortly afterwards the reducing action of aluminium trialkyl was exploited in other reactions and titanium tetrachloride-aluminium trialkyl combinations were employed for the production of highly crystalline polymers. (See note 2.) Natta utilizing Ziegler type catalysts polymerized propylene to obtain stereospecific products with the alkyl group on the symmetric carbon orientated on the same side of the polymer axis. Natta postulated that since these polymers displayed terminal vinylidene groups and tertiary terminal carbon atoms, the polymerization must be anionic in nature. This he hypothesized could take place by a mechanism in which the polymer fragment attached to the surface of the catalyst, could be displaced by approaching monomer. Because of the steric approach control exercised by the methyls, polymers of a preferred optical configuration could be envisaged. Such stereospecific products were conducive to the formation of crystal lattices. These polymers contrasted significantly with those obtained by the alkylation of aluminium trialkyl, which were amorphous in character. It is interesting to note that the polypropylenes obtained by orientated polymerization techniques showed greater tensile strength and heat resistance than the polyethylenes, and fibres prepared from the former polymers were again stronger than those of nylon.

Binary Ratios

The ratio of the binary components in a Ziegler type catalyst were shown to be important. Intractable products resulted if unsuitable binary ratios were employed. The independent components comprising the catalyst did not afford *per se* stereospecific products, whilst on the other hand the degree of stereospecificity was related to the lower valency state of the titanium atom. The influence of catalyst structure on the nature of orientated polymerizations has already been demonstrated in the diolefines. Natta using Ziegler type catalysts polymerized butadiene to obtain syndiotactic polyvinyl ethylene. The American workers modifying the binary ratios in these catalysts polymerized isoprene to *cis* 1,4-polyisoprene. Ameripol SN, a synthetic *cis* 1,4-polyisoprene showed an infra-red absorption spectrum almost identical with that of Hevea rubber. The influence of the titanium salt on stereospecificity was demonstrated by Natta who showed that the lower valency titanium salts improved the yield of isotactic polymer. Thus combinations of $TiCl_4$—$AlEt_3$ at 80° C. gave yields of 35% polymer. This was increased to 95% on utilizing trivalent titanium.

Other reducing agents could replace aluminium trialkyl in the polymerization of ethylene. Thus Grignard reagents and lithium alkyl hydrides were employed. Binary catalysts containing a Grignard reagent afforded hard polymers of butadiene and ethylene, such polymers containing 10% of diolefine. Substituting the Grignard reagent for lithium aluminium hydride, increased the diolefine content to 20%. The type of reducing agent employed appeared of importance for while triphenyl tin hydrides alkylated by adding to olefinic double bonds, aluminium trialkyl appeared to undergo progressive alkylation by migration of a hydrogen atom.

$$Ph_3\,Sn\,H + CH_2 = CH_2 \longrightarrow Ph_3\,Sn\,CH_2 \cdot CH_3$$

The formation of crystalline polymers has been associated with polymerizations carried out at the fusion temperatures of the monomer, although most of the techniques employed today are effected above room temperatures employing the principles of heterogeneous catalysis. The latter techniques embody the Ziegler and supported oxide type of polymerizations. Low temperature isotactic polymers have, however, been obtained using BF_3—etherate at —70° C. Isotactic polymers of vinyl iso butyl ether have been prepared in this way, the orientated polymer emerging from the liquid phase of added etherate. Polymers of 2-methyl styrene have also been prepared by such techniques.

The influence of the catalyst on the geometry of the resulting polymer has again been observed in the polymerization of butadiene, when using lithium and sodium metal respectively. Lithium, for example, polymerizes isoprene to the poly *cis* 1,4-form: substituting lithium for sodium, however, yields a mixture containing the *cis* and *trans* 1,2 and 1,4 polymers. Suitable lithium catalysts have been prepared by mixing the metal with an inert carrier as petroleum jelly. In binary mixtures using $AlMe_3$ and organo chromium complexes, the ratio of the catalyst components can determine either isotactic or sindiotactic characteristics.

Transalky Reactions

Ethylene has been polymerized by $TiCl_4$ and Am_1Na, the reaction appearing to involve some degree of transalkylation. Reduction and transalkylation reactions have been postulated for reactions governing the Ziegler type of polymerizations. Thus Grignard reagents which function as reducing agents can also function in transalkylation reactions as shown below.

$$SnBr_4 + EtMgI \longrightarrow EtSnBr_3 + MgIBr$$

When aluminium trialkyl was replaced by $SnBu_4$, the emergent polymer tended to

resemble those polymers obtained from the supported oxide techniques. Excess trialkyl in $TiCl_4$ mixtures gave tractable products and suggested the possibility of alkylation reactions taking place simultaneously with those of the orientated polymerizations. The advantages of the Ziegler crystalline products are well known. They give, for example, products which do not suffer from ductility failures. They also show enhanced resistance to stress and cracking.

The Effect of Solvents

The effect of solvents in orientated polymerizations is important. Polar solvents adversely influence the formation of stereospecific products. They possibly attack the active catalyst centres and so render the polymerization random in nature. The formation of co-ordinated complexes with tervalent titanium salts would *ex hypothesi* disturb the $AlMe_3$-$TiCl_4$ relationship in the catalyst. On the simplest of assumptions therefore the system would favour alkylation and the production of amorphous polymers. It is known that titanium salts can form 6-covalent complexes as a result of the formation of stable inner d^2sp^3 orbitals. When ether is used as solvent the degree of stereospecificity is reduced. In this example the catalyst has probably been rendered redundant by the formation of titanium complexes with the oxygen in the ether molecule. In the polymerization of isoprene, n-butyl lithium in heptane gives a polymer having a 90% *cis* 1,4 configuration. Substituting the paraffinic solvent for tetrahydrofurane gives no 1,4 polymer.

The Supported Oxides

The supported oxides yield stereospecific polymers but these vary with the structure of the oxide. Thus products having 90% crystallinity have been procured by using molybdena supported on alumina. Nickel on carbon on the other hand gives products having 80% crystallinity.

With the chromium oxides, the degree of crystallinity is of a lower order. At 80° C. to 90° C., CrO_3 on SiO_2 gives polymers with 2% crystallinity.

The supported oxide catalyst are not new in polymerization processes. Supported oxides of nickel and cobalt were used in combination with sodium, lithium and potassium hydrides in 1938. Waxy products were obtained. The supported oxide catalysts resemble the Ziegler type catalysts, because they are activated by reducing agents. Ethylene has been polymerized at 200° C. and at pressures of 1,000 lb. sq. in. using molybdena and reducing agents. Barium, calcium and strontium carbides act as catalyst promoters in the polymerization of ethylene. These polymerizations are usually carried out between 230° C. and 280° C. and at a pressure of 1,000 lb. sq. in. The resulting polymers vary from soft products with a molecular weight of 700 to tough resinous products with brittle points of —50° C. (ASTM Method D 256-52T) and impact strengths of greater than 2 foot pounds per sq. in. of notch (ASTM Method D 256-47T-Izod Machine). These carbides also extend the life of the oxide catalyst by possibly reacting with catalyst poisons. The carbides, however, influence the property of the resulting polymer. Thus in the polymerization of ethylene using molybdena and calcium carbide in equal proportions at 254° C. and 854 lb. sq. in. a polymer was obtained with a melt viscosity of 5 to 10 poises and a density of 0.964 at 24° C. If the carbide content was increased to 3 : 1, the resulting polymer had an increased melt viscosity but a lower density. Such an observation might suggest a reduction in crystallinity and the production of side chains.

Other co-catalysts employed are the hydrides of magnesium, calcium and barium. These polymerizations have been carried out between 130° C. and 260° C. and at pressures of 200 to 5,000 lb. sq. in. The hydrides are unique co-catalysts being able to prevent the alkylation reactions which occur when aromatic type solvents are employed.

Although from thermodynamic data, temperatures and pressures have a positive influence on the rates of polymerization as adduced from the below canonical equations:—

$$(i)\quad \Delta G_T = -18940 + 33.8T$$

$$(ii)\quad \Delta G_P = -RT\log_e P + \Delta G_T$$

So that

$$\Delta G_P = 18940 - (R\log_e P + 33.8)T$$

As $\Delta G_P \longrightarrow O$, P and T increase.

it can nevertheless be seen that other variants exercise a considerable influence on the ultimate yields and polymer characteristics. In the below experiments although the temperature and pressures favour polymerization rates in A as against B, such variants as the temperature of reduction of the oxide and the quantity of solvent used offset such positive thermodynamical influences.

Experiments	Amount of oxide used (grs.)	Pre-reduction Temp. °C.	Amount of Hydride (grs.)	Temp. of Polymerization ° C.	Initial Olefine Pressure	Hydrogen Pressure	Yield	Specific Viscosity x 10^2	Density
A	1.0	480	0.5	262–296	900 psi	150 psi	1.14	5.5	0.98
B	1.0	400	0.5	232	860 psi	140 psi	3.9	53.6	0.9601

A carried out in 100 c.c. xylene.
B carried out in 50 c.c. xylene.

Finally, the positive effect of hydrogen pressures in contrast to those of hydrogen pretreatment temperatures and olefine initial pressures respectively on the course of the polymerization may be observed below.

Experiments	Amount of oxide used (grs.)	Hydrogen Pre-treatment Temp. ° C.	Amount of Hydride (grs.)	Temp. of Polymerization ° C.	Initial Olefine Pressure	Hydrogen Pressure	Yield	Specific Viscosity x 10^2	Density
A	0.47	530	0.5	255	840	140 psi	295	32.9	0.9601
B	0.47	630	0.5	255	850	130 psi	24.2	30.1	0.9592

NOTE.—Yields are rated per gr. of catalyst used.

Note 1.

Because the caralyst is polar in hydrophobic solvents like pentane, the catalytic system is heterogeneous in nature. The reaction then probably takes place at the surface of the catalyst. The mechanism may then feature the Ziegler system, the organic moiety projecting into the solution from the surface of the catalyst. Owing to polarization at the metal site, the monomer displaces the anion to give a larger one, such a mechanism engendering the formation of long chains.

Note 2.

These bi-metallo complexes are thought to resemble the dimer . monochlorodimethyl aluminium, the metal atoms of the former being therefore linked through chlorine atoms. In catalysts of the following specie $(C_5H_5)_2TiCl_2AlEt_2$ the Ti-Cl and Al-Cl bonds have distances of 2.5Å, and slightly below that of the metal halides used in the Alfin reaction. The cyclopentadienyl fragments are united through $\delta\pi$- bonds.

Screen Printing Machinery

DUBUIT LTD., 8 Chase Road, Park Royal, London, N.W.10, have recently introduced two semi-automatic silkscreen printing machines, one for conical objects and containers and one for cylindrical objects and flat sheet (illustrated). The latter machine has an output of up to 1,500 articles per hour and can handle cylinders of up to 4 in. in diameter for flat sheet printing areas up to 11¾ in. by 7⅞ in. can be accommodated. Time switches control the intervals in the loading, printing cycle. The movement of the screen carrier is by electric motor which is fitted with a brake.

The conical printer has a production rate of 2,000 components per hour and operates on the turret principle with automatic squeegee operation and hand feeding. This machine has a range of from 0.2 in. to 2 in. diameter.

The Dubuit screen printing machine for flat and cylindrical objects.

Patent Review

The following abstracts have been made from specifications at the Patent Office, with the permission of the controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 3s. 6d. each (including postage).

B.P. 788,209. Self-adhesive tapes and films. To: Beiersdorf & Co. A.G. (Germany).

Applying to a film (polyisobutylene) an aqueous dispersion of polyethylene fused after evaporation to the film. The pressure sensitive adhesive is then applied to the other side of the film.

B.P. 788,210. Bottle closures. S. Hashimoto (Japan).

A hood of an elastic and plastic material (polyethylene, polyvinyl chloride, polyvinyl acetate) in a metal crown.

B.P. 788,263. Nail-lacquer bottle and brush. F. G. Mila (Spain).

With an internally threaded closure sleeve having a transverse partition from which on one side a brush protrudes protected by a screwed-on sheath.

B.P. 288,274. Manufacture of artificial flowers. A. E. Decomp (France).

The corolla is formed by rows of petals joined to a centre ring by elongations folded back to represent a pistil.

B.P. 788,329. Securing elements for constructional parts of synthetic material. To: Daimler Benz A.G. (Germany).

B.P. 788,399. Ball games apparatus. D. von Arnheim.

Ball, ball-thrower and catcher.

B.P. 788,406. Device for economising in the use of pastes, soaps and so forth. W. H. Sims.

To extrude residues from tubes. May be combined, e.g., with a toothbrush.

B.P. 788,426. Resinous coating materials and processes for the manufacture of such materials. To: Dr. Beck & Co. G.m.b.H. (Germany).

A low-molecular unsaturated polyester resin is mixed with an ethoxylene resin. The product is then mixed with a metal-alcohol compound and a liquid unsaturated monomeric compound. For insulating wires.

B.P. 788,536. Containers made of plasticized thermoplastic material and processes for their production. L. Rado.

A liquid oily substance as a thin layer on the inner walls to isolate the plasticizer from a substance packed therein.

B.P. 788, 547. Apparatus for producing flexible coated sheet material. G. Swindells. To: Imperial Chemical Industries Ltd.

Refers to the coating of sheet material in continuous stripes, each stripe being completely separated from its neighbour by uncoated stripes. The main features are a spreading knife and located in front of it one or more masking devices pressing on the sheet material to prevent coating. The devices are continued underneath the spreading knife at least to the back of it. For obtaining coated " breathable " fabrics.

B.P. 788,709. Closure device. To: Frame S.A. (Switzerland).

A plastic body with an internal thread enabling a bung to be screwed into it is inserted into an opening of the container. The portion of the body in the interior of the container is expanded by a metal ring forming a circular bulge fixing the body.

B.P. 788,734. Method and apparatus for the production of bodies of plywood or like material. W. J. Adams, J. E. N. Duggan. To: William Mallinson & Sons (Manufacturing), Ltd.

Provision of jig-positioned holes to locate the material on a mandrel, thus obtaining accurate overlapping for joining the material wrapped around the mandrel. For, e.g. making wastepaper baskets from plastic, or laminated plastic, or hods from resin-bonded plywood.

B.P. 788,779. Method of manufacturing reinforced synthetic plastic tubes. To: N. V. Polypress (Netherlands).

A thin non-reinforced plastic tube (1·5–4 mm. thick) is made by centrifugal casting, then placed on a core and provided with a reinforcing strip, e.g. of plastic-impregnated glass-fibre mat or fabric.

B.P. 788,815. Porous plates. L. Jungfer (Austria).

Microporous separators for accumulators made of a mixture of granular ebonite and at least one granular thermoplastic coalesced into an integral body under heat and/or pressure.

B.P. 788,977. Garden cloches. M. G. Strong (New Zealand).

An arched transparent (cellulose acetate, polyvinyl chloride) sheet in a frame (folded metal rim) with reinforcing straight metal strips.

B.P. 789,029. Hypodermic syringes. A. B. Astra Apoteharnes Kemiska Fabriker.

A two-part tubular plastic container encloses a compressed spring, a compressible ampoule and a two-pointed injection needle. On release of the spring the ampoule is compressed while the needle perforates the end of the container, then that of the ampoule.

B.P. 789,060. Domestic culinary machine. To: Robert Bosch G.m.b.H. (Germany).

Housing and cover part enclosing the electric motor and the speed reduction gearing may be made from a light synthetic material.

B.P. 789,119. Production of polyester tubes reinforced with glass fibres. To: Reichold Chemie A.G. (Germany).

Glass fibres impregnated with liquid unsaturated polyester resin mixture are wound on a core (tube) of pulp material covered with a cellulose hydrate foil. The resin is then hardened.

B.P. 789,133. Toy vehicle or toy air water craft. H. Steiner, sen., H. Steiner, jun., R. Steiner (Herrmann Steiner K.G.) (Germany).

B.P. 789,151. Cigar and cigarette holders. J. M. Barnett.

Filtering grains in the holder are retained by a perforated diaphragm at the opening for the cigar or cigarette. Near the other (mouthpiece) end is a restricted passage to hold back the grains.

B.P. 789,220. Moulding apparatus. J. C. Siegrist.

An injection moulding machine in which during a moulding operation the valve on the injection nozzle is automatically held closed until the required pressure is reached.

B.P. 789,250. Frames for motorcycles, autocycles or motor scooters. To: Anfida A.G. (Switzerland).

With an exchangeable fuel tank made of a bag of flexible synthetic material.

B.P. 789,254. Polymeric materials and their production. J. B. Rose. To: I.C.I. Ltd.

Rubber-like bodies of trifluoronitrosomethane and tetrafluoroethylene.

B.P. 789,281. Bin dispenser. J. F. Knott, S. Heselov.

For dispensing small tins (baby foods, etc.). A number of vertical members moulded to form zig-zag tracks held apart by tubular spacers.

B.P. 789,294. Film bag containers for liquids. To: John Waddington Ltd., T. N. Gaunt, N. V. Watson.

A film (polythene, etc.) bag in a carton of stiff paper allowing access to a valve for inserting a discharge tube without uncontrollable spilling.

B.P. 728,297. Heat-hardenable resinous compositions containing epoxide resins. G. Barnett, K. D. Drakeley. To: Bakelite Ltd.

A coating composition of an epoxide resin and an unsaturated polyester resin produced without a polymerization catalyst or a hardening agent.

B.P. 789,321. A heel for correcting flat-footedness and other deformities of the feet. A. J. Helfet. To: Walk-Rite Appliances (Proprietary) Ltd.

May be moulded from plastic material.

B.P. 789,334. Dinghies, rafts and like craft. To: R.F.D. Co., Ltd.

A tubular watertight gunwhale surrounding a flexible fabric floor of sandwich construction with mechanical spacing means inside.

B.P. 789,355. A link strap of synthetic material. A. Kundert (Switzerland).

Each link member is moulded from a flexible synthetic material and comprises a female ring connected by a flexible web to a male portion.

B.P. 789,386. Discardable package for foodstuffs. To: Glaces Gervais (France).

Made from an extruded plastic sheath welded transversely at both ends. A straw having a bevelled end with a protective cover is immersed in the liquid or semi-liquid foodstuff.

B.P. 789,453. Electric accumulators. B. R. Field. To: Alkaline Batteries Ltd.

A venting plug with a slightly conical orifice larger at the bottom arranged at such an angle to the vertical axis that no line parallel to the axis passes through the orifice. The orifice is closed by a slidable cover.

B.P. 789,454. Apparatus for the production of moistureproof sheet wrapping materials. R. L. Lloyd. To: British Cellophane Ltd.

The nip is formed by a pair of rollers provided at each end with frusto-conical extrusions in contact with each other (one end tapering outwardly, the other end inwardly). The width of the gap is adjusted by relative axial movement.

B.P. 789,481. Process for the production of foam material. J. Bauer (Germany).

By treating a synthetic polyurethane foam with an acid or alkaline reacting substance. The effect may be intensified by subjecting the foam during the treatment to a mechanical treatment (continuous compression and release) to promote the rupture of the cell walls.

B.P. 789,521. Flexible tubing. H. G. Schauenburg (Germany).

Made of a number of rings of, e.g., polyvinyl chloride each (helical) ring having at its,

opposite edges a male bead and a female bead extending around the whole edge. The hose is longitudinally collapsible.

B.P. 789,522. Flexible tubing. H. G. Schauenburg (Germany).

Made of a helically wound strip or of rings with a hollow bead containing an armouring (wire or plastic). The beads have flanges to be welded or adhesively united to the other edge of the strip or to an adjoining ring.

B.P. 789,616. Inflatable tent convertible to one or more airbeds. J. E. Wojcik.

B.P. 789,617. Holder for securing a lady's head-dress to the head. E. Buhler (Switzerland).

The holder has resilient (slit) outer teeth and centre teeth. The group of centre teeth is arranged at an angle to the outer teeth for invisibly clamping a head scarf.

B.P. 789,630. Devices for attaching handles to brushes and the like. L. R. Sadler. To: Betterwear Products Ltd.

Refers to the use of a polythene washer.

B.P. 789,632. Permanent magnet adhesion plates. To: Deutsche Edelstahlwerke A.G. (Germany).

For holding in the art of printing a rubber sheet charged with iron powder. The plate or strip like pole cap members project only a small amount (1 to 3 mm.) and their edges are covered with a synthetic resin to form a flush and level adhesion face.

B.P. 789,635. Fish container. A. R. Cordemeyer (Netherlands).

A corrosion-proof container, e.g. of glass fibre reinforced polyester resin, of rectangular shape and a number of holes in the bottom so positioned that in crosswise and coaxially stacked containers the drip water zones are limited to the four edges and cannot reach the contents of the lower containers.

B.P. 789,698. Polyethylene compositions and articles made therefrom. To: E. I. Du Pont de Nemours & Co. (U.S.A.).

A composition of polyethylene and a saturated primary fatty acid amide containing 10 to 16 carbon atoms, possesses a markedly reduced film-to-film coefficient of friction.

B.P. 789,759. Collapsible brushes. J. H. Woolmer.

A casing with pivotally mounted bristle bars. The bars are either collapsed under a sliding lid or held erect and projecting from the casing by the same lid in a different position on the casing.

B.P. 789,766. Drinking straw and method, and machine for making the same. S. F. Rabin, M. Scisorek, J. Bayard.

Incorporating a flavouring or other drink-modifying material.

B.P. 789,816. Manufacture of bottles and other hollow articles from plastic material. A. Amigo.

When shearing the tube from the extrusion head it is simultaneously closed by means of a movable mould half, then conveyed to the stationary mould and inflated within the mould.

B.P. 789,828. Adhesive plaster materials and the methods of and apparatus for making such materials. Scholl Mfg. Co., Ltd., W. Tennant.

Medicinal plasters which will be waterproof and permit moisture to evaporate through it, by making apertures in an adhesive coated backing strip. The adhesive must at least partially set so as not to flow to seal the apertures again.

B.P. 789,894. Containers. British Vacuum Flasks Co., Ltd., M. A. Hassid.

A cylindrical container is made up of a blank of a laminated sheet of metal and polyvinyl chloride with the edges turned over along the seam and pressed together. The same process is used for fixing a threaded insert.

B.P. 789,935. Closures for vacuum flasks or the like. To: Thermos Ltd. (U.S.A.).

A hollow (polythene) stopper for large-mouthed flasks is reinforced by an axial cylindrical section integrally formed with the hollow stopper portion or with the cap holding the stopper portion.

B.P. 789,865. Apparatus and method for moulding plastic material. To: Dunlop Rubber Co., Ltd.

When moulding precision articles the dies in a ring on a rotatable wheel have to be kept closed till the material sets. To take this burden off the machine each pair of dies is held closed by its own lock (a self-locking mechanism such as a toggle mechanism).

B.P. 789,966. Apparatus and method for moulding plastic material. To: Dunlop Rubber Co., Ltd.

Refers to the removal of material from a central hole for reuse.

B.P. 789,967. Apparatus and method for moulding plastic material. To: Dunlop Rubber Co., Ltd.

Refers to the parting of the plastic strip between successive dies.

B.P. 789,975. Process of lining the inside of wooden barrels. F. Fessel. To: W. Roth, A. Kern. (Fassfabrik Diener & Roth).

A condensation product which hardens at room temperature is applied to the inner surface of the barrel together with a substance to react with the hydroxyl groups in the cellulose of the wood.

B.P. 789,981. Heat sealing of thermoplastic coated paper webs for making bag tubes. D. G. J. Nicholson. To: Paper Sacks Ltd.

An oxyacetylene burner arrangement where the burner flame issues in the direction of the receding travel of the paper in the region of the nip of the closing seam. Control is through valves by electromagnetic or servo-motor means in synchronism with the travel of the bag-tube web.

B.P. 790,132. Handles for furniture. F. R. Blow. To: Ingall, Parsons, Clive & Co., Ltd.

With pairs of bosses moulded or cast about screw pins and each boss having an ornamental rose interposed between handle bar and mounting face.

B.P. 790,151. Manufacture of brushes. E. K. Cole Ltd., A. B. Glanvill.

Tufts of monofilaments of plastics material are fed into a mould cavity in which the ends in each tuft are fused together before moulding the handle about them.

B.P. 790,200. Production of semi-moistureproof sheet wrapping material. W. Berry, H. J. Ward, E. G. Sanderson, M. A. Maloney. To: British Cellophane Ltd.

Regenerated cellulose base film is coated on one side with semi-moistureproofing surface coating and on the other side with a non-semi-moistureproofing, water-repellent surface coating. This prevents absorption of moisture and staining when packaging fresh produce or processed meats.

B.P. 790,201. Production of moistureproof sheet wrapping material. W. Berry, H. J. Ward, E. S. Sanderson, M. A. Maloney. To: British Cellophane Ltd.

Regenerated cellulose base film coated on one side with a moistureproofing surface coating (" moistureproof " means permeable to water-vapour of less than 700 gr. per 100 sq. metres per hour at a certain temperature and humidity), on the other side with a non-moistureproofing, water-repellent coating. For wrapping, e.g. fresh meat.

B.P. 790,209. Production of cross-linked plastics. To: Farbenfabriken Bayer A.G. (Germany).

B.P. 790,216. Glass fabrics and plastic materials containing the same. Wm. Mackintosh & Co., Ltd., E. P. Goodall, D. J. Hodgson.

Glass fabrics as reinforcements have usually the same strength in the warp and weft directions. The moulded article, on the other hand, may have to have mechanical properties which differ in different directions. A fabric as reinforcement woven from a warp of untwisted rovings of continuous glass filaments fed direct from a creel to a loom and a weft consisting of light and widely spaced yarns or rovings has strength almost entirely in one direction to be arranged as required.

B.P. 790,220. Hypodermic syringe ampulla. A. S. Elinger.

A plastic ampulla having such a cross-section of the wall of its hollow body that one or more lines are defined along which the body folds when the fluid is expelled through the nozzle.

B.P. 790,241. Method of making microporous film. R. Smith-Johannsen (U.S.A.).

By fusing fine particles of thermoplastic material while dispersed throughout a continuous inert matrix material which is then dissolved out. For battery separators, filters, sheets, films where microporosity is required.

B.P. 790,244. Control knobs. G. Birkbeck, L. Fisher. To: Mullard Radio Valve Co., Ltd.

With a tapering slot and resilient metal wedge.

B.P. 790,253. Construction of composite plates or panels. To: Daimler-Benz A.G. (Germany).

At least one layer with an unbroken surface and one layer with lines of staggered cup-like depressions formed by sloping walls fused to the first layer or fixed by adhesion over the whole base surface of the depressions. A light stiff panel results of good appearance.

B.P. 790,255. Fibre boards and like articles of compact fibrous materials. To: Celanese Corp. of America (U.S.A.).

An aqueous slurry of particles consisting of or containing fibres is fed on to a perforated surface. The slurry contains also a water-insoluble acidic copolymer of vinyl acetate. The water is removed (by suction) and the deposit dried. For, e.g. wall boards and book covers.

B.P. 790,278. Artificial Christmas tree. To: Warren Christmas Tree Inc. (U.S.A.).

A central sectional stem and a number of integrally formed leaf-like elements pliably flexible yet self-supporting in a preset position. As materials, polystyrene and polyethylene are mentioned.

B.P. 790,304. Spoon-type feeding utensils. H. T. Lawrence.

An infants spoon with graduations.

B.P. 790,307. Seals for attachment to fabrics. L. G. Stanley. To: Alfred Stanley & Sons, Ltd.

A plastic tablet with a rectangular tongue integral therewith and a separate loop member pushed over the tongue. A tape is threaded through the selvage of the fabric and the slot and doubled back, then the loop is pushed up and a solvent applied effecting the attachment between tape loop and tongue only to be separated by destruction.

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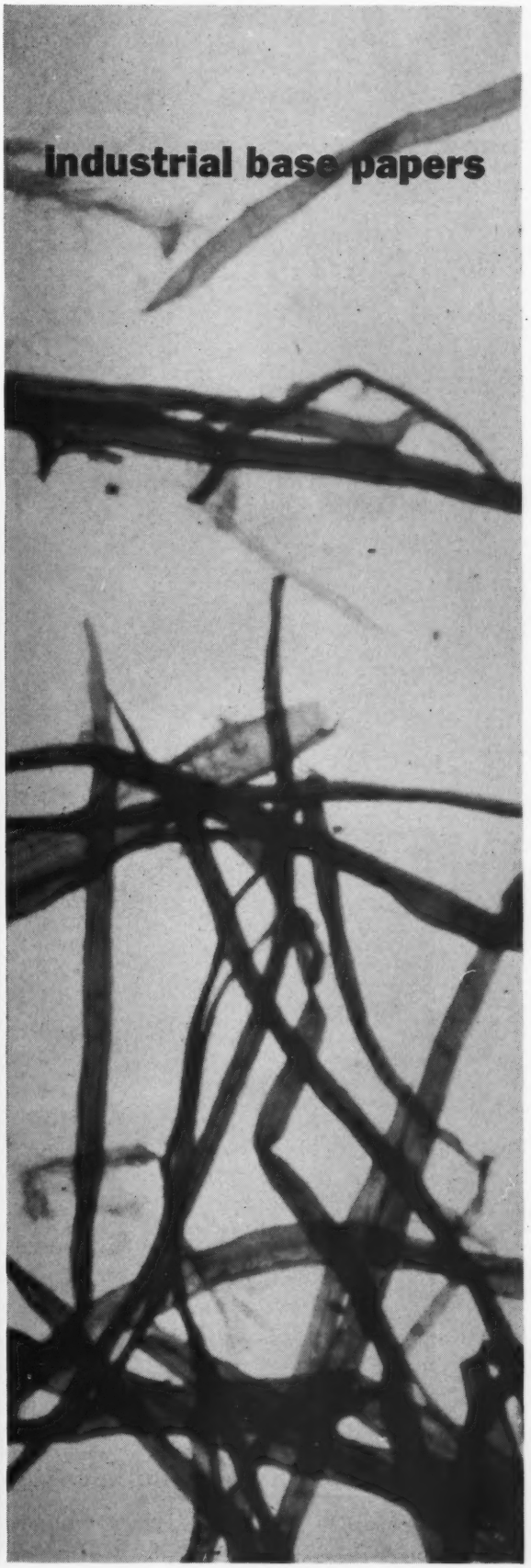

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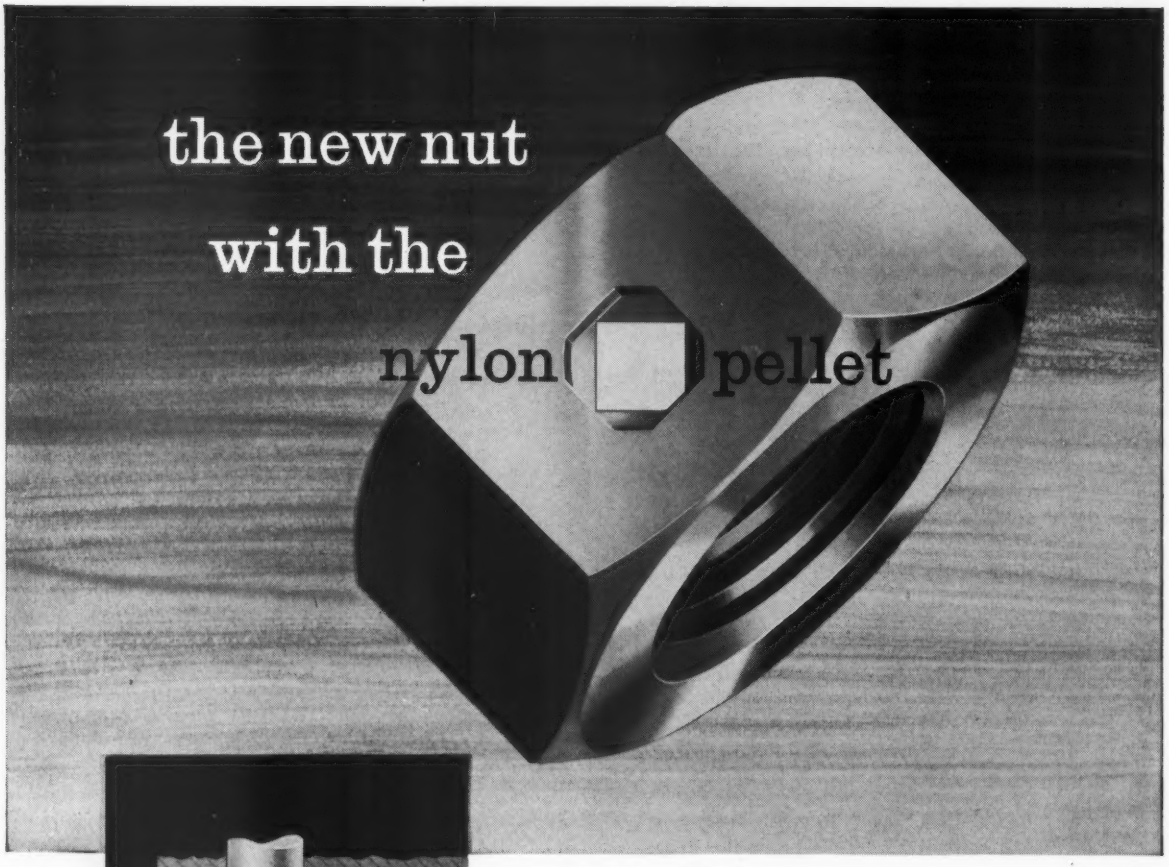

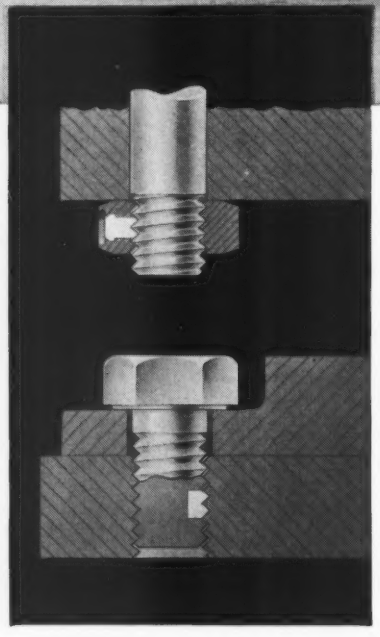

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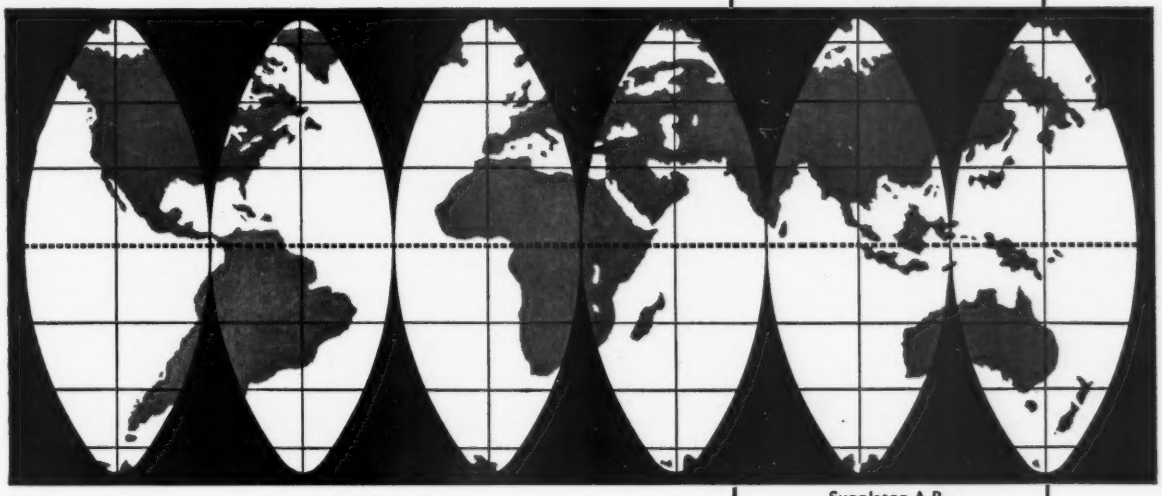

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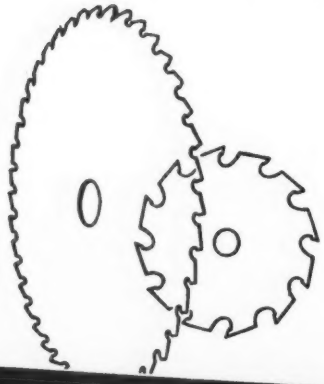

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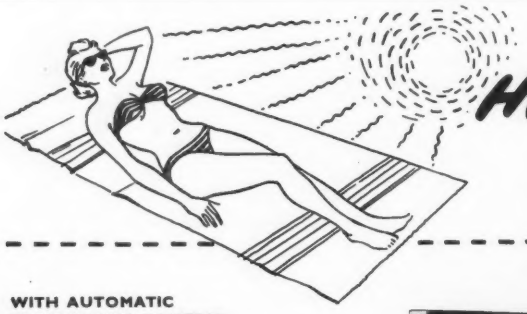

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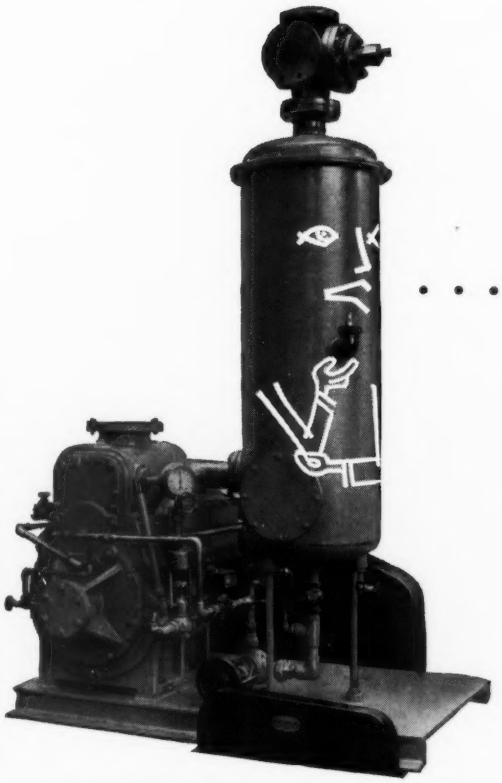

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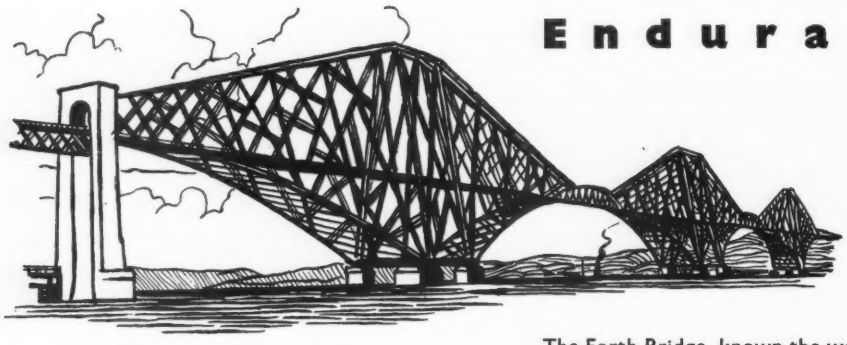

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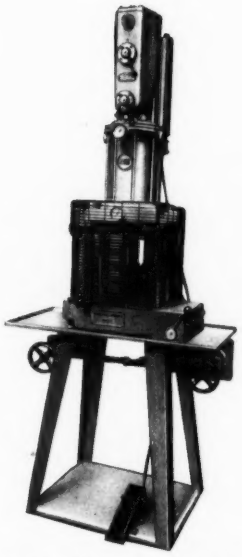

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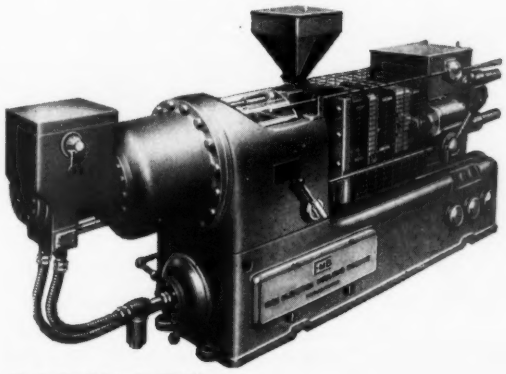

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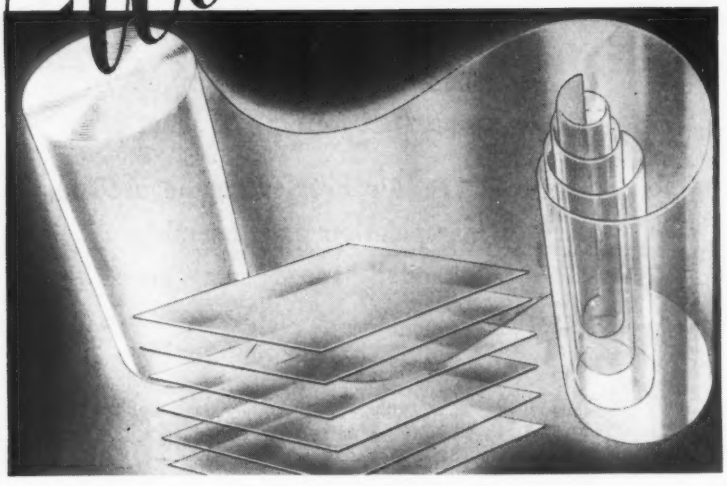

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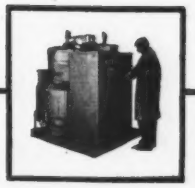

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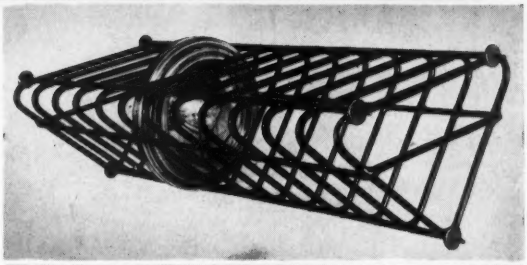
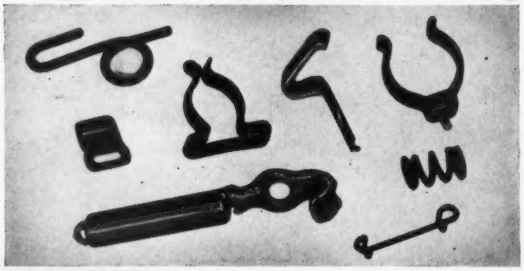


B ▶



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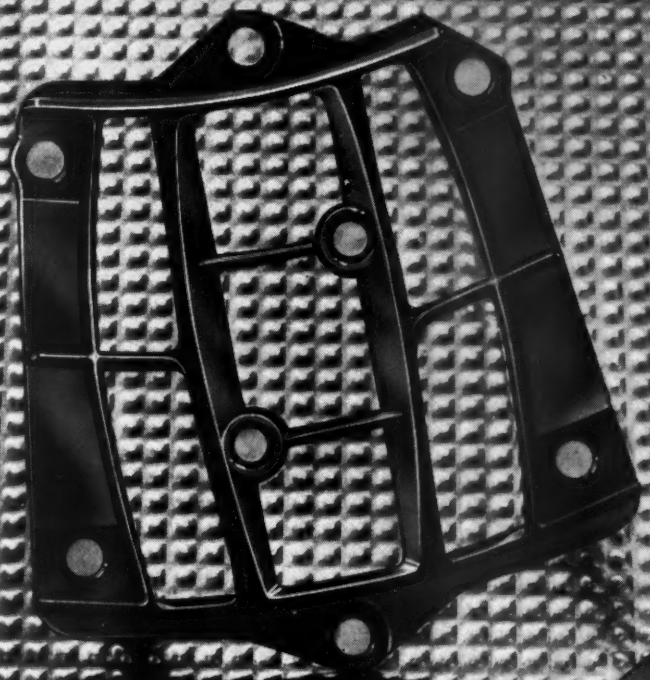

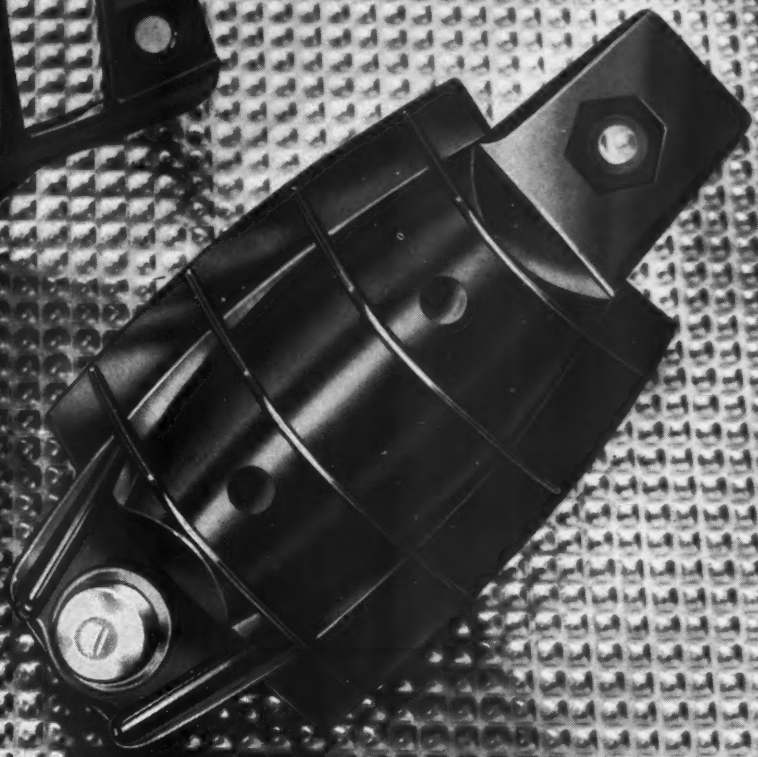

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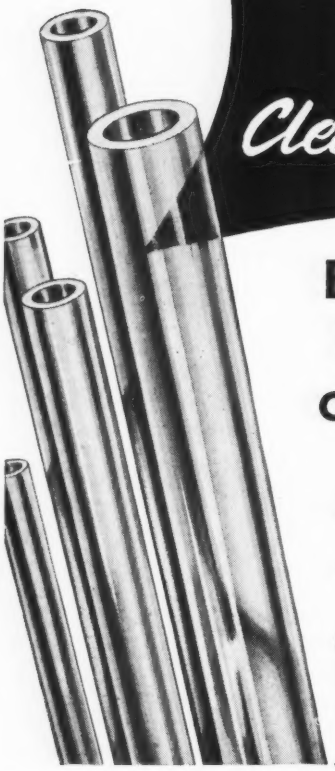

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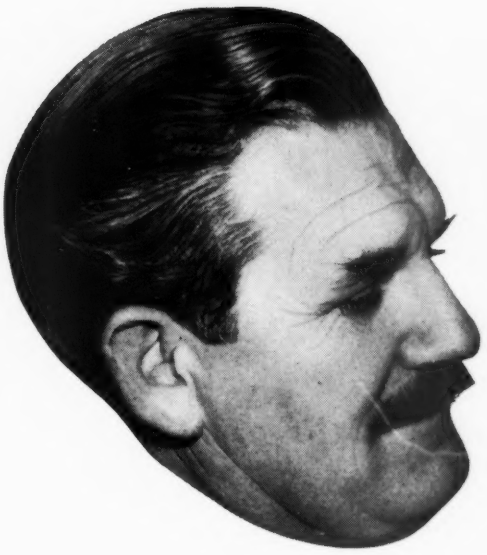

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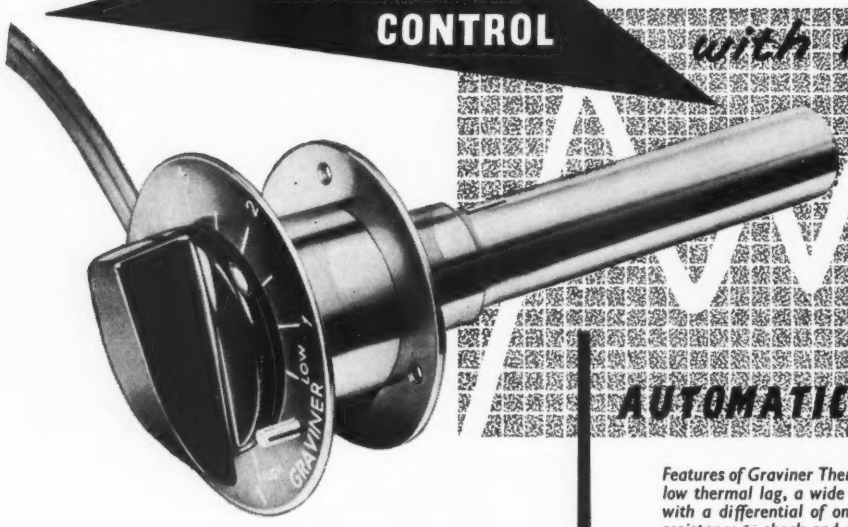

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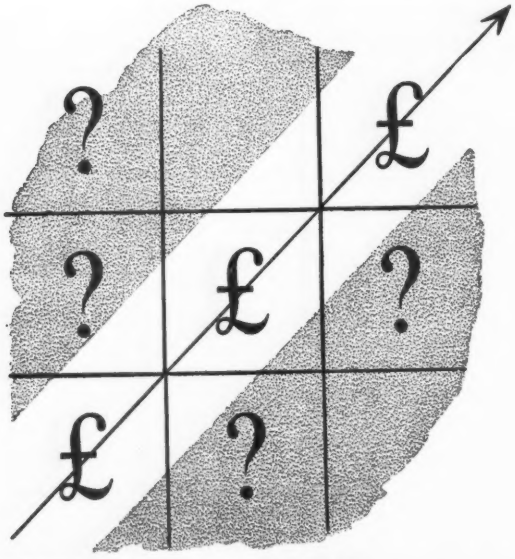

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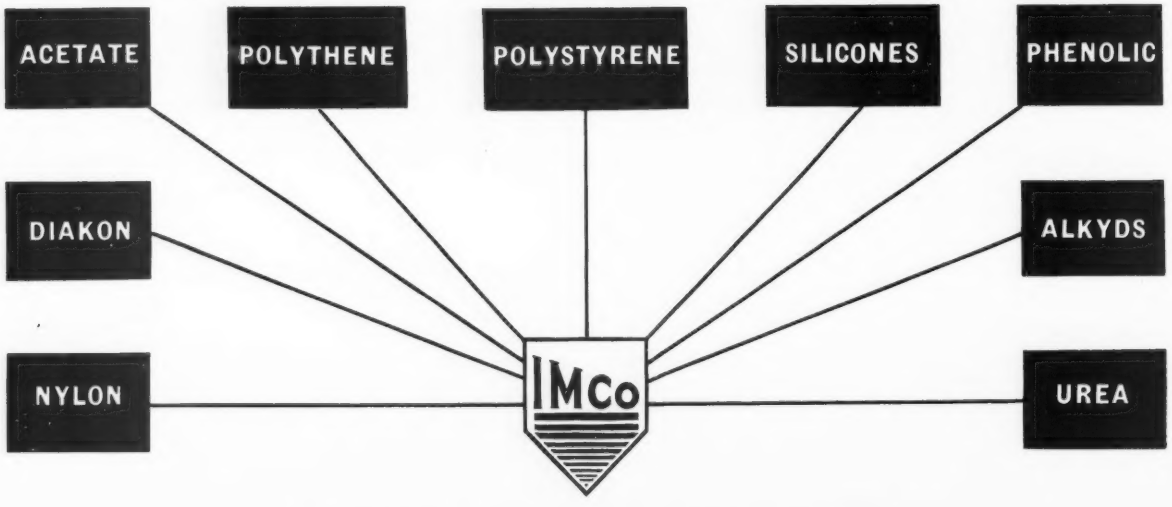

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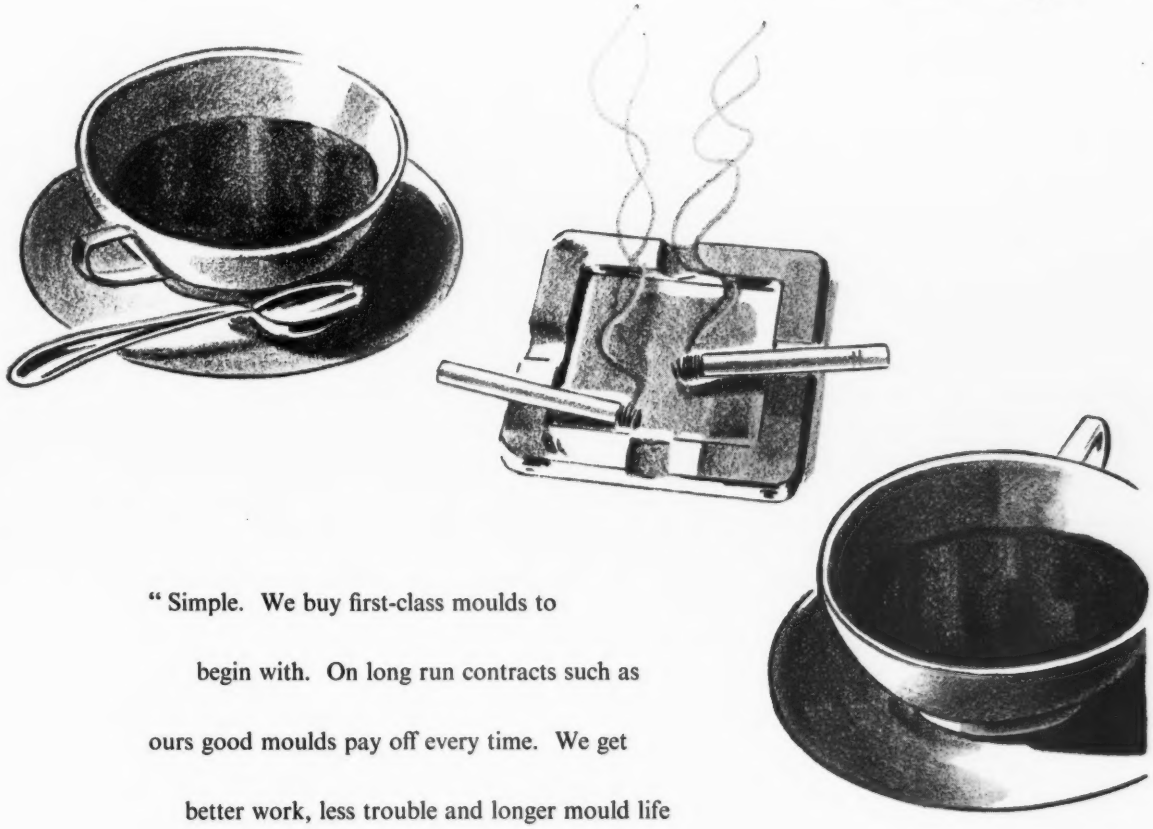

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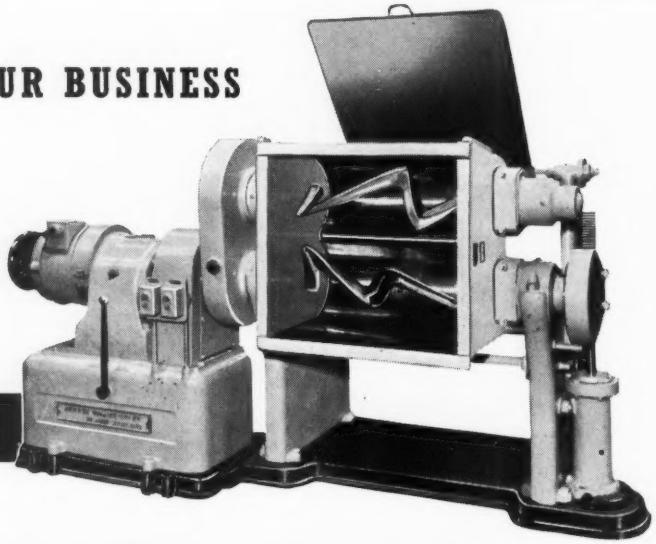

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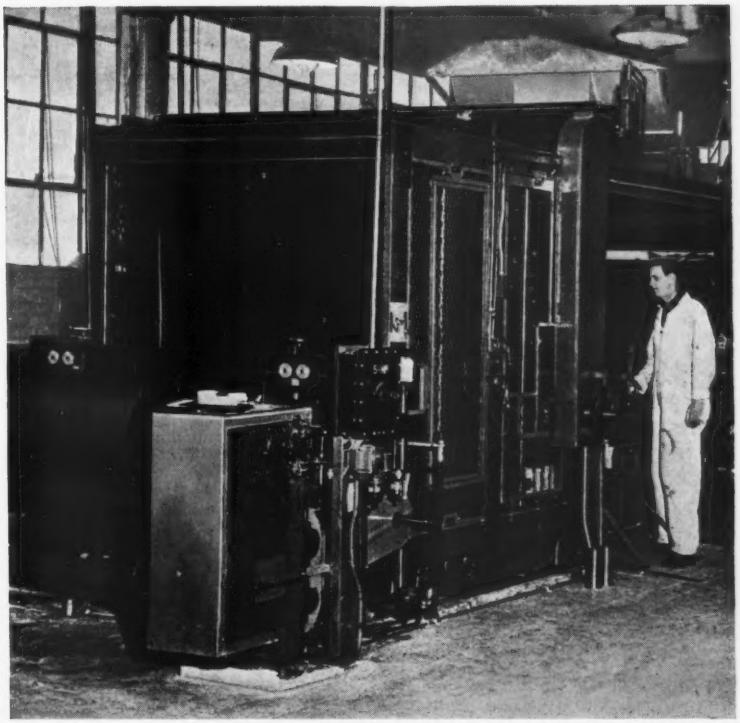

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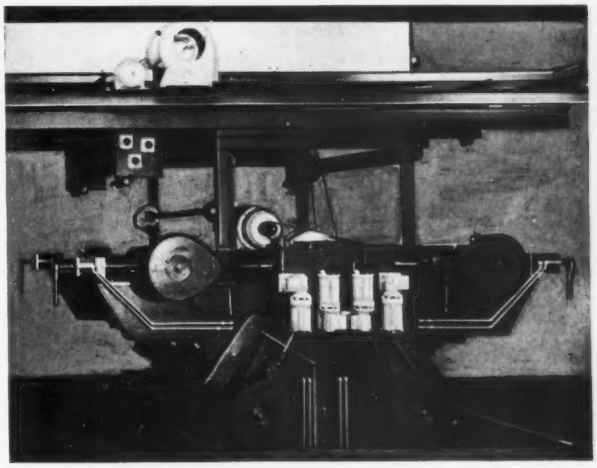

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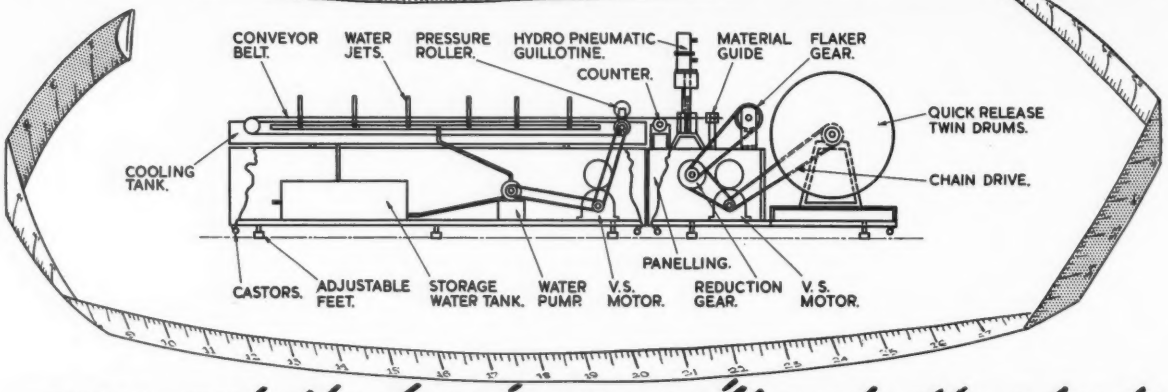

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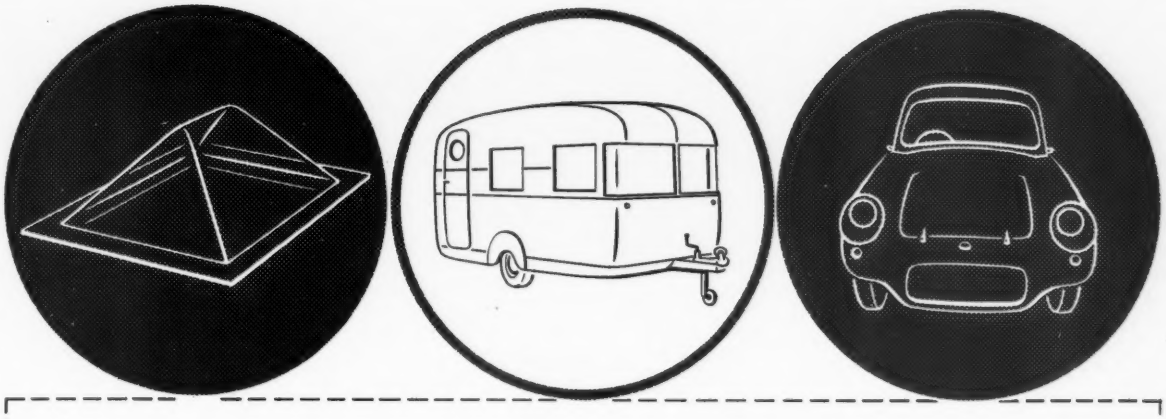

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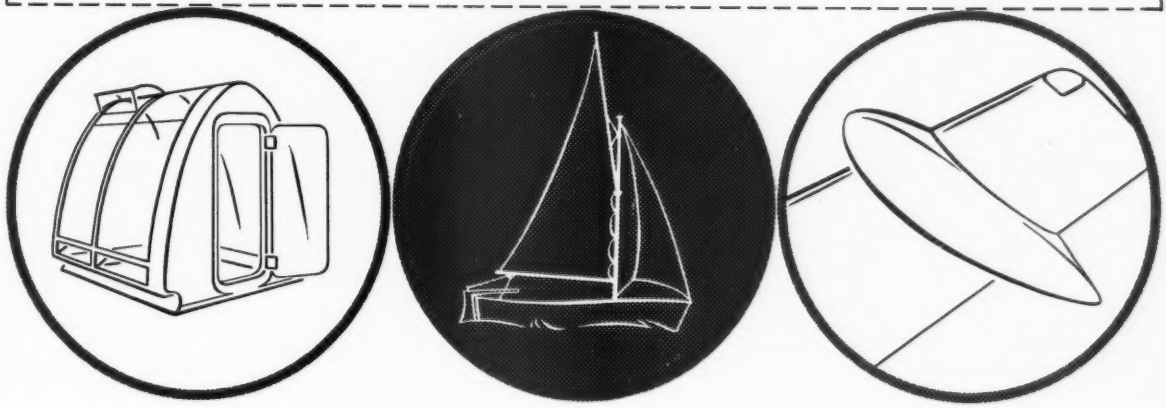

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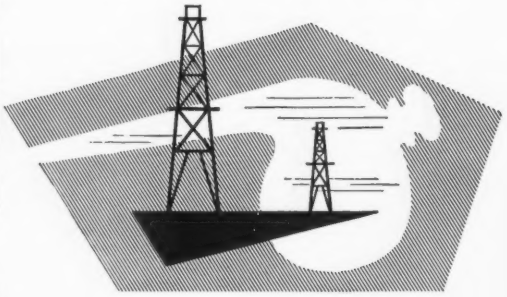

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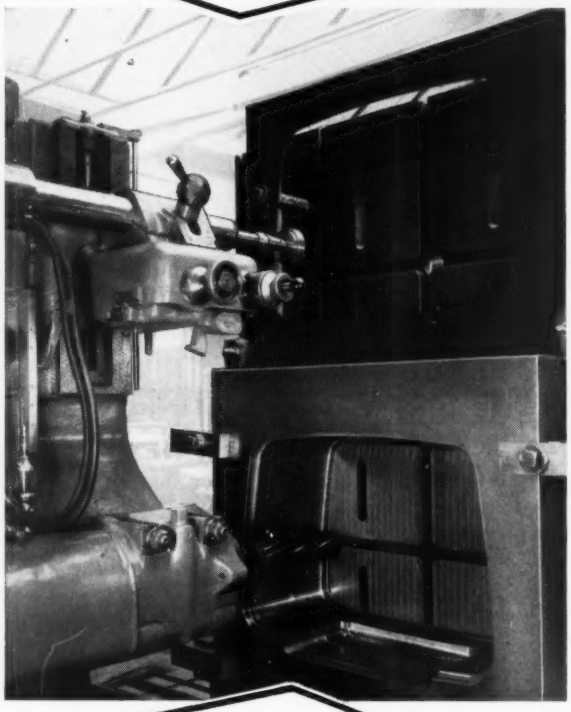

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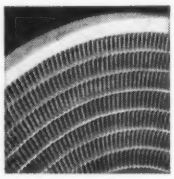

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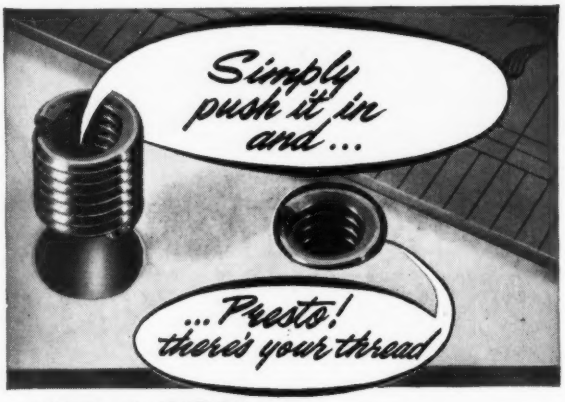

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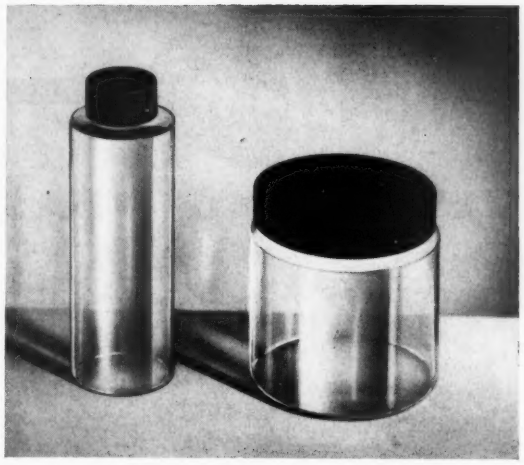

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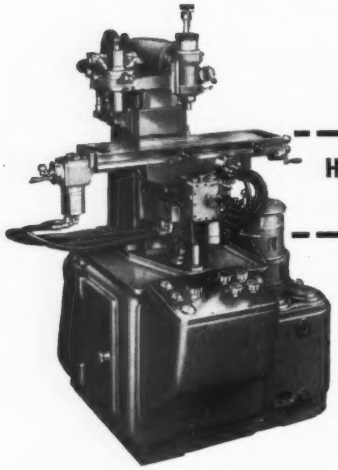

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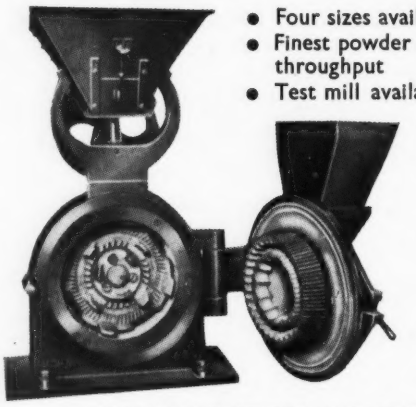

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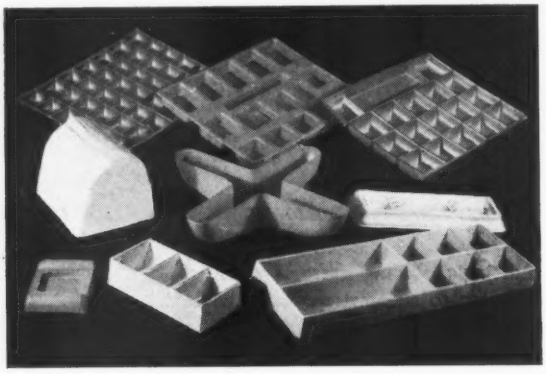

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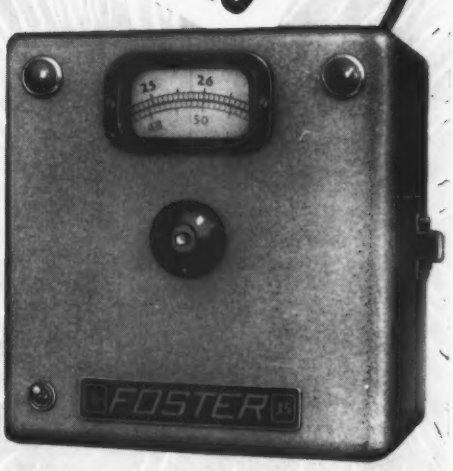

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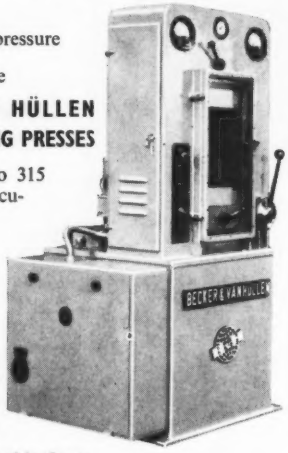

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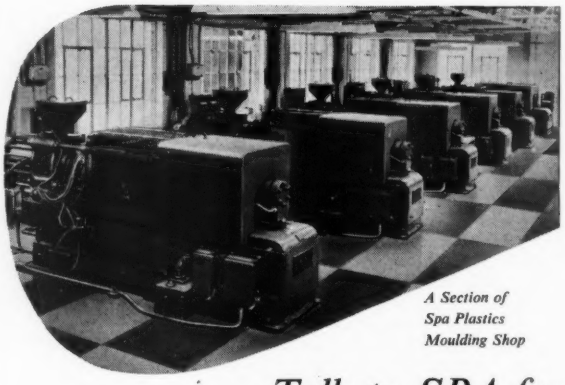

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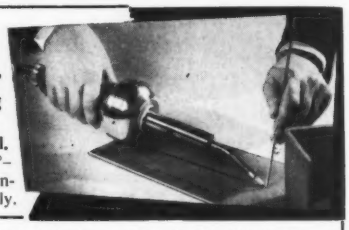

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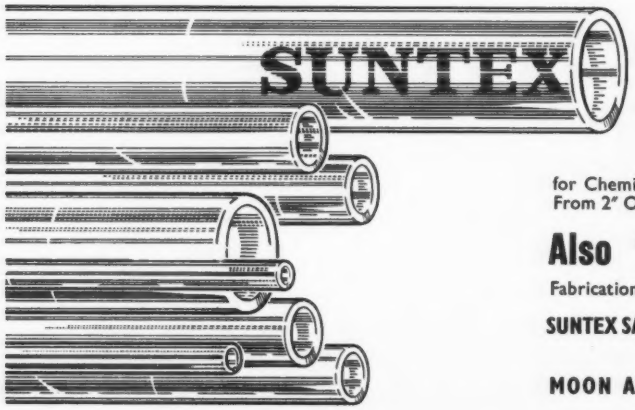

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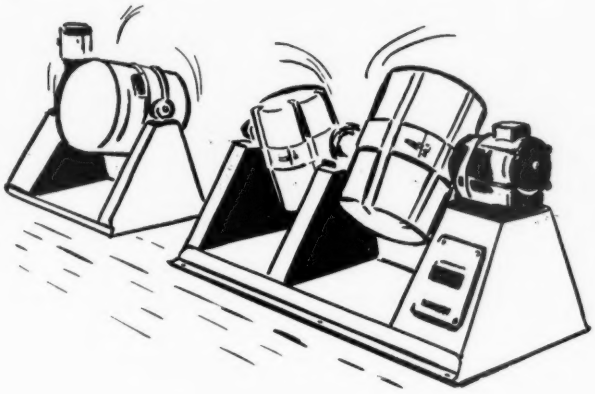

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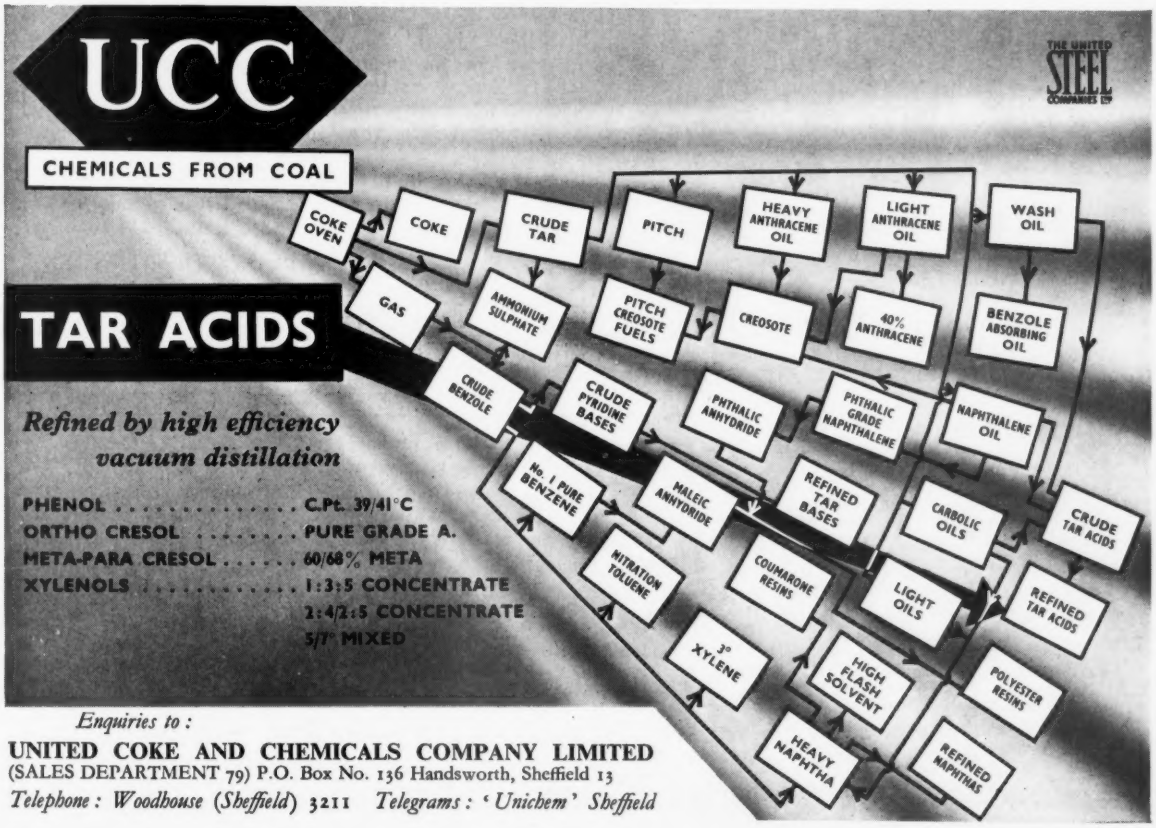

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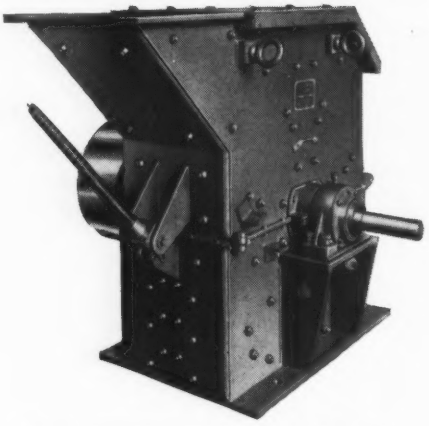

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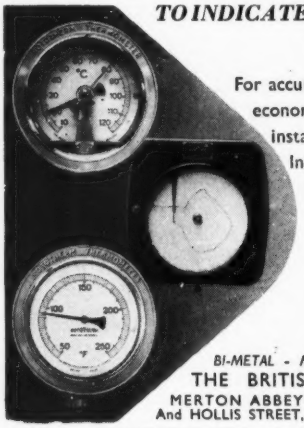

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R. H. CURRELL, A.S.A.A.
Clerk.

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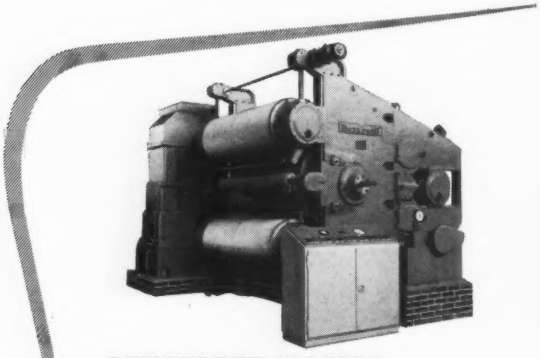

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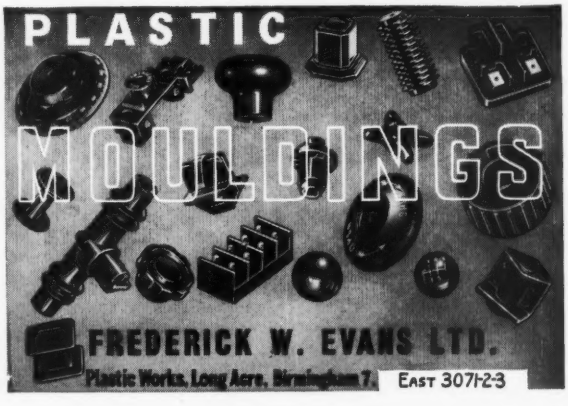

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Plastics Classified Advertisements

PRESS DAY.—Classified advertisements for the June issue must be received at Head Office by first post Monday, May 26.

Last-minute additions and deletions are accepted by telephone from trade advertisers up to noon. Advertisements received too late for a particular issue are automatically inserted in the succeeding one unless instructions to the contrary are received.

RATES.—6d. per word (minimum 12 words 6/-). Each paragraph charged separately and name and address must be paid for. Semi-displayed setting 2 gns. per single column inch. Series discounts of 5% for 6, and 10% for 12 consecutive insertions allowed to trade advertisers.

TERMS.—Strictly net and prepayable. Monthly accounts for settlement by the end of the month following insertion are allowed to trade advertisers if satisfactory references are provided.

REMITTANCES.—Cheques and postal orders should be crossed and made payable to TEMPLE PRESS LIMITED and instructions sent addressed to the Manager, "Plastics," Bowling Green Lane, London, E.C.1.

THE PROPRIETORS retain the right to refuse or withdraw advertisements at their discretion and are not responsible for clerical or printers' errors although every care is taken to avoid mistakes.

BOX NUMBERS.—Private advertisers desiring to have replies sent care of "Plastics" may do so on payment of 1/- to cover booking and postage, plus cost of four extra words. Box numbers must not be used for the purpose of circularizing and the proprietors do not undertake the distribution of such matter received. To avoid mistakes in forwarding, Box numbers should be carefully and legibly copied and replies sent to Box P000, care of "Plastics," Bowling Green Lane, London, E.C.1.

DEPOSIT SYSTEM.—Facilities are available to readers to purchase advertised goods on approval by depositing the purchase price with "Plastics." Full details on application. Commission 1% (minimum 2/-) on amount deposited.

HEAD OFFICES.—Bowling Green Lane, London, E.C.1, England. Telephone: Terminus 3636. Telegrams: "Pressimus, London Telex," Telex: 23839.

BRANCH OFFICES: Baylis House, Hurst Street, Birmingham, 5. Telephone: Midland 6616. 50, Hertford Street, Coventry. Telephone: Coventry 62464. 1, Brazennose Street, Manchester. Telephone: Deansgate 6114-8. 12, Renfield Street, Glasgow. Telephone: Glasgow Central 1413.

AGENTS WANTED

MANUFACTURERS' AGENT required by small progressive company producing vacuum formed plastic products for display and general commercial use. Present customers are national advertisers. Full co-operation and assistance offered. Box P481, care of Plastics. 248-12

AUCTIONS

ESTABLISHED 1855.
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MANCHESTER, 2.
Phone, Central 1937/8.
Grams, Russonken, Manchester. zzz-151

BUSINESS OPPORTUNITIES

PUBLIC COMPANY manufacturing compression and injection mouldings interested in purchasing company producing similar goods. Satisfactory profits essential. Continuity of present management preferred. Replies in strictest confidence to Box P484, care of "Plastics." 250-1332

ADVERTISER wishes contract 20 oz. polythene or polypropylene moulding to interested manufacturer, 10,000. Box P4823, care of "Plastics." 248-x5396

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W. BRUCE BROWN, F.R.S.A., M.S.I.A., designer specializing in the development of new plastic articles. 140, Roding Rd., Loughton, Essex. Tel. Loughton 4138. 250-1338

GLASS FIBRE KITS

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INSURANCE

BOOTHS Motor Insurance Specialists.
Booths for Private and Business Cars.
Booths No Claim Bonus 33⅓ to 50%.
Booths (Insurance), Ltd., (P), 6 Booth Street, Manchester, 2. zzz-163

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MIXERS AND BLENDERS. Usually a varied selection available for quick delivery. Enquiries welcome. Winkworth Machinery Ltd., 65 High St., Staines, Middlesex. 250-1115

COHEN Downstroke Hydraulic Presses, 1–50-ton and 2–40-ton, with Towler Electraulic High Speed Pump and Oil Tank and including interconnecting piping.
Duncan Stewart Tabletting Machine, complete with 5 h.p. Brooks Motor.
Raymond Radio Heaters, two Model H7/A, one Model H5/A.
Offers to De Garrs & Allen Ltd., 121 Harwood St., Sheffield, 2. Phone 20909. 248-20

Machinery, Tools and Plant (contd.)

HYDRAULIC. Frazer mono-radial pumps, new and secondhand, in stock. Thompson & Son (Millwall), Ltd., Cuba St., London, E.14. East 1844. zzz-158

FEW BTH powerful extractor-blower fans, £20. Fraction manufacturing cost. Bellangers, 306 Holloway Rd., London, N.7. North 4117. 248-21

BOILERS

John Thompson, Lancashire, 24 ft. × 8 ft. 6 in. dish ended, 5,500, 7,000 lb./hr. 120 p.s.i.
Scotch type marine, 9 ft. × 8 ft. 6 in., 3,400 lb./hr., 140 p.s.i.
Two Farrar self-contained, internal furnace, locomotive type boilers, 15 ft. × 6 ft. diameter, 2,500 lb./hr., 100 p.s.i.
Oil-firing equipment can be supplied if necessary.
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Phone Shepherds Bush 2070.
AND
STANNINGLEY, NR. LEEDS.
Phone Pudsey 2241 248-22

FOR SALE. Three 8-oz. Alfred Herbert Reed Prentice standard cylinders in good condition. Apply: Hughes Brushes Ltd., 32 Ajax Ave., Trading Estate, Slough, Bucks. 248-25

ONE Lansing Bagnall Stand-on Reach Fork Truck, complete with Ironclad battery of 240 b.h. Capacity 1,680 lb. 40 in. load length. Overall length 60 in., overall width 34½ in., overall height 95 in. Telescopic lift (electro-hydraulic) of 12 ft. Lifting speed 20 ft./min. Electro-hydraulic reach 30 in. Equipped with two adjustable forks 30 in. long. Less built-in charger. Fitted with overload and low voltage release circuit breaker and electric push-button type horn. Asdowns Ltd., Eccleston Works, St. Helens, Lancs. Phone St. Helens 3206. 248-16

TOOLMAKERS AND PRECISION ENGINEERS.
PLASTIC MOULDS—
Injection Moulds.
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SPECIAL PURPOSE MACHINES—
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DESIGN, DEVELOPMENT & MANUFACTURE—
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W. E. CUCKSON & SON, LTD.,
FACTORY 7/F
TREFOREST INDUSTRIAL ESTATE,
PONTYPRIDD, GLAM.
Treforest 2038. 250-1335

REDIFON DIELECTRIC HEATER, type HB.20.B. Output 1.75 kW. Fitted with oversize oven. Reconditioned. Box P4815, care of "Plastics." 248-14

Two only. 15-ton Vertical Injection Presses with push backs, less valves and guards. £75.
One only. 15-ton Thompson Upstroking Compression Press with gas platens, less valves and guards. £65.
One only. 10-ton Bradley & Turton Upstroking Compression Press with gas platens, less valves and guards. £40.
Two only. Gas Pre-heaters. £7 10s. 0d. each.
One only. 4,000-ton Hydraulic Press by John Shaw. £4,000.
Box P4226, care of "Plastics." 248-34

Machinery, Tools and Plant (contd.)

BROWN & SHARPE Omniversal Milling Machine. Also ZOCCA Universal Grinder, various attachments, capacity 5 in. swing × 12 in. between centres. 1954 machine in excellent condition. Box P486, care of "Plastics." 248-10

PLASTICS MACHINERY
Hydraulic Presses of all sizes. Injection Machines. Extruders. Mixing Mills. Hydraulic Pumps and Accumulators.
Send your requirements to the specialists.
REED BROTHERS (ENGINEERING), LTD.,
REPLANT WORKS,
WOOLWICH INDUSTRIAL ESTATE, S.E.18.
Phone: Woolwich 7611. 248-35

THE FOLLOWING MACHINES, ideal for mould manufacture, are for disposal and have been rebuilt throughout to close limits and are virtually as new:—
Van Norman No. 6 Ram-type Universal Mill. Table 30 in. × 7 in. Speeds 80–1,450 r.p.m.
Wanderer Universal Mill. Table 31 in. × 9¾ in. Speeds 96-1,500 r.p.m. Dividing head, etc.
Grand Rapids Hydraulic Surface Grinder. 8 in. × 24 in. Infinitely variable speeds.
Norton Hydraulic Grinder. 6 in. × 18 in.
Browne & Sharpe No. 3 Tool and Cutter Grinder.
Reasonable prices will be accepted for any of these machines. Inspection London. Details from Box P485, care of "Plastics." 248-9

FOR SALE
ONE PECO INJECTION MOULDING MACHINE TYPE 40M.
Very little used. Purchased new July, 1956.
For details as to price, etc., apply:
R. & A. G. CROSSLAND LIMITED,
CARTBRIDGE LANE,
WALSALL. 248-39

WADKIN RADIAL ARM DRILL for sale. Model 10A. Motorised for 380/440/50. Chuck capacity ¾ in. Speed of motor 2,700 r.p.m. Maximum working radius 5 ft. 6 in. Minimum working radius 14½ in. Maximum size sheetwork any length by 4 ft. F. J. Edwards Ltd., 359 Euston Rd., London, N.W.1. 248-40

TWO OILDRAULIC DOUBLE-SIDED PRESSES, by B. & J. Wright, for sale. Pressure 90 tons. Maximum stroke 3¾ in. Between side frames 28 in. Top platen 24 in. × 20 in. Sliding table. Drive to Fraser type HV25. Mono-radial pump by Brook motor and starter for 400/440/3/50. Steel plate frame. F. J. Edwards Ltd., 359 Euston Rd., London, N.W.1, or 41 Water St., Birmingham, 3. 248-41

MACHINERY, TOOLS AND PLANT WANTED

EXTRUDER AND VACUUM FORMING MACHINES wanted. Send full details Box P4515, care of "Plastics." 250-1122

WANTED. Two semi-automatic injection moulding presses with a capacity of ¼ oz. to 2 oz. Injection cylinders to be suitable for granulated p.v.c. feeding. Box P489, care of "Plastics." 248-6

INJECTION MOULDING MACHINES required, 1 oz. to 8 oz. Also Masson Cutter. Box P4819, care of "Plastics." 248-x6926

WANTED 1-OZ. to 3-OZ. INJECTION MOULDER. Raylite Supplies Ltd., 21 Arkwright St., Nottingham. 248-38

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YOUR DESIGN
OUR DESIGN
MOULDS TO YOUR SATISFACTION
AND OURS.
PRECONOMY CO. LTD., TOOLMAKERS.
Eastfield side, Sutton-in-Ashfield, Notts.
zzz-146

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COMPRESSION MOULDS.
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OUR DESIGN — YOUR DESIGN.
ENGRAVING. HEAT-TREATMENT.
ANY OR ALL SERVICES AVAILABLE.
LEIGH TOOL & GAUGE CO., LTD.
EMPIRE WORKS, CLEVELEYS, LANCS.
Established over 25 years. zzz-172

MOULDS WANTED

MOULDS WANTED. Send details of your surplus or redundant Injection and Compression Moulds. Box P445, care of " Plastics." 249-1026

MOULDS wanted for plastic farmyard animals. Samples or details to Box P4822, care of " Plastics." 248-x7013

PATENTS

THE PROPRIETOR of British Patent No. 721,527 for " improvements in and relating to boxes," desires to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. Further particulars may be obtained from Marks & Clerk, 57 and 58 Lincoln's Inn Fields, London, W.C.2. 248-32

PRODUCTION CAPACITY AVAILABLE

INJECTION MOULDINGS by I.O.G. Industries, Ltd., 41 Marshgate Lane, Stratford, E.15. Maryland 2804. 256-1120

MEDIUM CAPACITY AVAILABLE. Tool and Mould making. Parker Plastics Moulds, Walthamstow, London. Larkswood 2806. 249-1259

NYLON, POLYSTYRENE AND ACETATE INJECTION MOULDINGS up to 2 oz. Reliable service. Latest-type machines. Keen co-operation on new lines. W. H. Adamson Plastics, Ltd., 39 Hedlev St., Maidstone. 250-1121

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VISIJAR LABORATORIES. LTD.
THE LEADING CRAFTSMEN IN
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PROTOTYPE AND REPETITION.
OFFICIAL I.C.I. STOCKISTS " PERSPEX."
SHEET, TUBE, ROD.
STOCKISTS AND FABRICATORS OF " FORMICA."
149 LONDON ROAD, CROYDON, SURREY.
Phone, Croydon 8228 (two lines) zzz-133

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2-32 OZ. INJECTION MOULDING CAPACITY AVAILABLE. Write to Spa Plastics (Division of Spa Brushes Limited), Chesham, Bucks. Phone: Chesham 81200. zzz-168

EXPERIENCED FABRICATORS IN CORROSION RESISTING PLASTICS. Ducting, tank lining, pipe installations are speciality of A.C. Plastic Industries, 231 Old St., London, E.C.1. CLE 0231. 250-1112

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VACUUM FORMED PLASTICS. Design, printing and production capacity available. The Delta Plastics, Worcester Place, Oxford 57838. 250-1117

MOULDS, INJECTION, COMPRESSION AND TRANSFERS, DIESINKING, DESIGNS. Competitive prices. Russell Engineering Co., Ltd., Russell Rd., Croydon. Thornton Heath 4128. 222-175

SORTING, Washing, Chipping, and Screening of customer's materials carried out under expert supervision. P.V.C., polythene, etc. Leeplas Products, Canal Wharf, Canal St., Leigh, Lancs. 248-1262

Production Capacity Available (contd.)

GLASSFIBRE reinforced plastic mouldings by Payne & Payne Ltd., 6/10 Priory Mews, London, S.W.8. Own design and pattern making department. Expert laminating team. Phone Macaulay 7687. 252-1304

ALL TYPES INJECTION MOULDINGS, 2 oz., including tool manufacture and design service, under one roof. O.P.H. Ltd., Old Brickworks, Church Road, Harold Wood, Essex. Ingrebourne 41513. 222-179

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INVITED FOR
INJECTION MOULDINGS.
WESTMINSTER PLASTICS LTD.,
TEMPLE WORKS,
41 OLD CHURCH RD.,
CHINGFORD, E.4.
Phone Silverthorn 7927. 222-178

INJECTION MOULDING CAPACITY available up to 4 oz. Nylon, polystyrene, polythene and acetate. Modern plant. C.W.C. Equipment Ltd., King's Grove, Maidenhead, Berks. Phone Maidenhead 2275. 248-26

The Plastics section of G.Q. Aircraft Developments Ltd., is now able to undertake design of moulds and tools for all types of plastic materials, both in the industrial and domestic fields.

The section led by a senior designer with many years experience in the plastics industry, is able without delay to assist in all problems involving the use of plastics, or the designs of moulds for plastic details.

G.Q. AIRCRAFT DEVELOPMENTS LTD.,
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Southampton
Southampton 24849. 248-19

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VIRGIN POLYSTYRENE FOR DISPOSAL. Virgin stocks of general purpose and high impact polystyrene moulding powders for disposal approximately 600–700 lb. per colour. Nine shades medium to light, in original sealed bags. Box P4415, care of " Plastics." 248-31

BLACK G.P. POLYSTYRENE PELLETS, as new, for sale in 1 ton lots, 1s. 7d. per lb. Box P476, care of " Plastics." 248-1301

BLACK POLYTHENE GRANULES. Large supplies always available at 1s. 11d. per lb. Box P472, care of " Plastics." zzz-177

PLASTIC DISCS.
EX BUTTON BLANKS.
Enormous quantities in all sizes and colours, cheap to clear. Write for stock lists and prices to :
DORMER PLASTICS LTD.
TRADING ESTATE, WEST HARTLEPOOL.
248-42

POLYTHENE TAPE. Natural or ivory. Continuous length reels, ½ in. to 3½ in. wide, 0.010 in. to .060 in. thick. Box P482, care of " Plastics." 250-1333

ACRYLIC SHEETS.
Brand-new, clear, from manufacturer's stock in Denmark:
4,500 sheets 0.7 mm.
4,050 sheets 0.9 mm.
1,700 sheets 1.1 mm.
700 sheets 1.2 mm.
For sale at 20% below list prices.
Size: 450 mm. × 200 mm.
Box P4810, care of " Plastics. 248-5

NYLON SCRAP for disposal. Please apply to Box P555, care of " Plastics. 248-27

60 TONS PLASTIC VENEER " ULTRAPAS " OFF-CUTS. (Phenolresin and Melaminresin.) Burnproof, etc., for bar and kitchen tables, trays, etc., about 40% 160 cm. × 40 cm. × 122 cm., 50% 200 cm. × 9 cm. × 20 cm., 10% 60 cm. × 9 cm. × 20 cm. All 1.3 mm. thick. Polished surface. Mixed colours: Red, Green, Grey and speckled. Offered at 2s. 11d. per lb. C.I.F. London. Cindico (G.B.) Ltd., Littlewick Green, Maidenhead, Berks. 248-23

Raw Material (contd.)

REGULAR QUANTITIES of polythene, polystyrene, p.v.c., for disposal. Box P4613, care of " Plastics." 248-1261

CUEX LTD., can offer all at prices well below current list:—
Polystyrene.
Cellulose acetate.
Polyethylene.
P.V.C.
Polyvinyl butyral.
Perspex and Diakon.
Send now for details.
Cuex Ltd., 270 Corporation St., Birmingham, Central 5474. 248-33

PLASTICS (MANCHESTER), LIMITED,
BRITAIN'S LEADING STOCKISTS
OF
PERSPEX SHEET, ROD, TUBE.
HANOVER MILLS,
BUXTON STREET,
LONDON ROAD,
MANCHESTER, 1.
Phone ARD. 4567 (5 lines). 248-309

RAW MATERIAL WANTED

HERBERT CONNOR LTD., Buyers of all Scrap. Top prices paid on any terms for Polythene, Polystyrene, Diakon, Perspex, P.V.C., Acetate, Nylon, in lump, scrap articles, ground and re-ground forms and film offcuts. Please send samples and details to: 120 Beaufort Park, London, N.W.11. 248-29

WANTED, Polythene scrap. Write to Box P221, care of " Plastics." zzz-132

SPOT CASH BUYERS of all thermoplastic injection scrap and redundant virgin lots. Regular collections. WG Plastics, 14 Cambridge Park Mews, Twickenham, Middlesex. Popesgrove 1800. 258-1305

POLYTHENE SCRAP. Top prices paid on any terms for any form of polythene scrap, i.e. extrusion lumps, scrap articles, film offcuts, ground and re-ground forms. Please send details and samples to: Herbert Connor Ltd., 120 Beaufort Park, London, N.W.11. 248-30

POLYETHYLENE MOULDING POWDERS, lay-flat tubing and scrap of all kinds wanted against prompt cash payment. Box P398, care of " Plastics." zzz-147

BROCKWELL PLASTICS LTD., 50 Hollingbourne Rd., S.E.24, will purchase redundant polyethylene scrap of all kinds. We collect and pay cash on collection. Box P399, care of " Plastics." zzz-148

LEEPLAS PRODUCTS require all types of scrap: p.v.c., polythene, polystyrene, etc., in any form. Best prices paid. Details and samples to: Canal Wharf, Canal St., Leigh, Lancs. 248-1263

WANTED all types of Polythene Scrap. Send details and samples to: Tyruplex Ltd., 111 High St., N.W.10. Elgar 2684. 248-28

ACETATE SCRAP wanted. Regular supplies required by London user. Brief details and price to Box P4824, care of " Plastics." 249-1336

THERMOPLASTIC SCRAP. We always buy large and small quantities and pay prompt Cash. Send offers to J. W. Nash & Co. Ltd., 27 Beethoven St., W.10. Ladbroke 4655/6/7. 248-36

ALL GRADES of nylon scrap required. Box P408, care of " Plastics." 248-37

REFRIGERATION & AIR CONDITIONING PLANT

FRIGIDAIRE LOW TEMPERATURE REFRIGERATORS, 49 in. wide × 28 in. deep × 34 in. high. Ex. Ex large national user, suitable A.C. or D.C. deep freezing, storage of ice-cream, frozen foods, etc. Price £40 each. Domestic refrigerators, service cabinets, and cold rooms also available. A.R.C., 134 Great Portland St., London, W.1. MUSeum 4480. zzz-171

SITUATIONS VACANT

TOOLMAKER required. Experience moulds essential. Permanent and high rate. Seaforth, 60 Oakhurst Rd., Southend, Essex. 248-1052

FOREMAN MOULDER required. Small shop near London. Essential fully experienced. Write Box P463, care of " Plastics." 248-1258

DESIGNER-DRAUGHTSMEN required for Plastics Machinery preferably with experience in Extrusion and ancillary equipment. Good working conditions and non-contributory Pension Scheme in operation. Write in confidence giving full details of experience, age, salary required, to N. Browne, Bone Bros., Ltd., Manor Farm Rd., Alperton, Wembley. 248-1303

GOLDEN OPPORTUNITY for Designer-Draughtsman with small and progressive firm of moulders, compression and injection. Only those with the necessary experience and qualifications who are prepared to work hard and take responsibility with a view to executive position, need apply. Write stating full details of experience and salary required. Box P479, care of " Plastics." 248-1302

Situations Vacant (contd.)

WE REQUIRE an experienced and energetic man to take charge of our Compression Moulding Shop. Must be capable of obtaining highest possible output from both man and machine. Permanent and well-paid position to the right man. Apply with full details of experience, age and salary required, Seaforth, Watchett Works, Oakhurst Rd., Southend-on-Sea. 248-1299

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Graduate chemists are required for applied research on cast resins for use in electrical and electronic equipment. A young man who has completed his National Service and is interested in new polymers and methods of using them would have considerable scope to develop his ideas.

Applications, quoting reference W.10 should be made on the appropriate form obtainable from:—

PERSONNEL MANAGER,
METROPOLITAN-VICKERS ELECTRICAL Co., LTD.
TRAFFORD PARK, MANCHESTER, 17.

248-1300

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EXPERIENCED SALES REPRESENTATIVES required to promote sales of p.v.c. products to manufacturers of p.v.c. garments and fancy goods. There are two vacancies: (1) Manchester and Northern Counties, and (2) The Midlands. Position carries good remuneration. Non-contributory staff pension and life insurance scheme in operation. Apply to Sales Director, Rubber Improvement Ltd., P.V.C. Division, Wellingborough, Northants. 248-24

TECHNICAL SALES REPRESENTATIVE required. To cover Northern area. For modern and expanding firm of trade moulders. Injection and compression. Experience an advantage but not essential. Salary in accordance with experience and ability. Permanent position for right man. Pension scheme. Car provided. Write in utmost confidence to: Godfrey Holmes (Plastics) Ltd., Wragby, Lincoln. 248-17

WANTED. Free-lance Draughtsman for plastic moulds. Write or phone. 48 Wallwood Rd., E.11. LEY. 6131/8251. 248-18

CHEMIST, preferably organic with plastics experience, required for commercial development of new materials and products. Suit ambitious man aged 30–35. Box P483, care of " Plastics." 248-11

Situations Vacant (contd.)

REPRESENTATIVE required providing an agile brain capable of assimilating common sense—no particular academic qualifications required. Must have tenacity and drive in following up enquiries received by moulding company. Age of secondary importance. Good prospects for man with confidence in himself. Box P4813, care of " Plastics." 248-2

CHEMIST. Company in specialized packaging field require graduate, not over 28, to be responsible to the Technical Manager and take charge of control and development work on raw materials and products. The starting salary will be by arrangement, but not less than £750 per annum. Contributory pension scheme. Assistance with housing considered. Factory situated in Hertfordshire. Applications from men expecting to graduate shortly will be welcomed. Box P4812, care of " Plastics." 248-3

SENIOR PLASTICS AND FILM CHEMIST required by prominent Anglo-American company developing its products in this field.

The successful applicant will be in the 30–40 age group, of PL.D. or Honours degree standard in chemistry or chemical engineering, and with a minimum of five years' experience of plastics and film research and development backed by a wide knowledge of these products.

The position will entail responsibility for organizing and co-ordinating the work of a group of assistants, and personal qualities necessary for carrying out successful administration will also be required.

An excellent starting salary will be offered, together with full participation in employee benefits which include pension and life assurance schemes. Expansion of the Company offers attractive prospects of a progressive career.

Details of qualifications and experience to date should be sent to:

Box P4816, care of " Plastics."

248-13

PLASTICS factory in London area require Assistant to Production Manager to take charge of p.v.c. calendering unit. Applicants must be of outstanding ability, preferably graduates with engineering or chemical background. Calendering experience desirable but not essential. This important appointment offers excellent prospects, existing personnel have been notified. Superannuation scheme in operation. State details of previous experience and salary required. Reply to Box P4814, care of " Plastics." 248-1

Situations Vacant (contd.)

LABORATORY TECHNICIAN with experience in the handling of all types of laboratory equipment, required by large company in the Midlands. Please state age, experience and salary now being received. Box P487, care of " Plastics." 248-8

GLASSFIBRE. A position has become vacant in the West Midland area for an experienced Technician to take charge of a department covering production and development. Applicants must state experience, age and salary required. Box P488, care of " Plastics." 248-7

MILL SHOP SUPERVISOR required for London Factory. Experienced rubber and plastics compounding and with sufficient chemical background for testing, etc., must be able to handle labour and production from Banbury Mixers on shift work. Age 30/50. Apply with full details, qualifications, previous experience and positions held to Box M.4859, Haddon's, Salisbury Sq., E.C.4. 249-1337

NYLON EXTRUSION

An experienced Plastics Engineer is required by the Plastics Division of a large company for development work, particularly on nylon extrusion. Salary according to experience and qualifications. Superannuation fund and profit-sharing bonus. Box P4811, care of " Plastics." 248-4

SITUATIONS WANTED

GLASSFIBRE. Design Engineer, five years, experience in U.K. and overseas, thorough knowledge of design, development and production of glassfibre mouldings, seeks position. Box P4817, care of " Plastics." 248-x6848

WORKS MANAGER, fully experienced in vacuum forming, requires change with scope for advancement in London area. Box P4818, care of " Plastics." 248-x6814

PLASTICS ENGINEER, good practical experience on injection moulding, extrusion, and rotary casting, requires interesting position with progressive firm. Box P4821, care of " Plastics." 248-x7012

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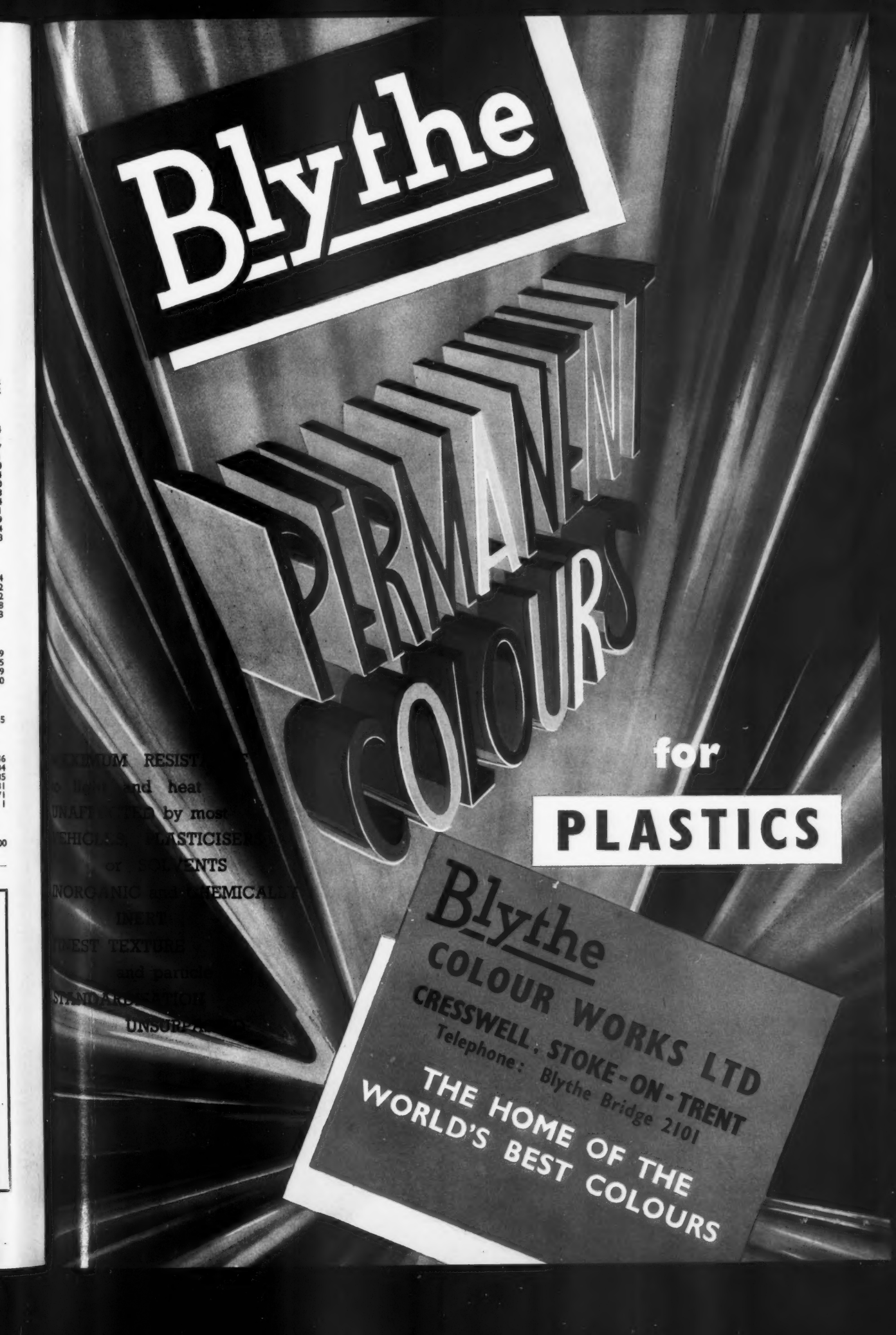
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